

**Lessons Learned from
California's Marine Life Management Act
Public Review Draft**

Prepared under the
MLMA Lessons Learned Project

December 14, 2009

About the MLMA Lessons Learned project:

The Harty Conflict Consulting & Mediation [HCCM] project team was selected to conduct a lessons learned study of the Marine Life Management Act [MLMA] as described in the RFP issued by the Ocean Protection Council on October 27, 2008. In the words of the Request for Proposals "Both DFG and the Commission have agreed that summarizing lessons learned from the previous FMP-approval processes could help to streamline efforts in the future. Additionally, because each past FMP creation process involved vastly different protocols, standards, costs, and time investments, a study evaluating comparative lessons learned could function as a useful reference for future efforts. The study will evaluate the successes and challenges of the implementation of the MLMA and provide recommendations to direct future MLMA efforts by DFG and the Commission."

About this document:

This is a review draft of the second report prepared to assess lessons learned about the implementation of the MLMA. The first report addressed Task One under the contract scope of work: a description of California's experience implementing the MLMA. This report combines Tasks Two and Three: evaluating the MLMA, identifying lessons learned, and providing recommendations for improving future implementation. This draft report is intended to serve as both an evaluation and a catalyst for identifying alternatives, looking backward as well as toward possible futures for California's management of its living marine resources.

Comments invited:

Comments are invited to improve the accuracy of this draft report. Specific MLMA experiences and identification of reliable sources of relevant information are particularly welcomed. Those comments will inform preparation of the final report.

Please send comments in electronic format to: MLMALL@scc.ca.gov. **Due by:** January 31, 2010

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LESSONS LEARNED

from California's Marine Life Management Act

Draft Tasks Two and Three Combined Report: Evaluation, Lessons Learned, and Recommendations

December 14, 2009

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Executive Summary

The Marine Life Management Act of 1998 (MLMA or Act) has been described as a “paradigm shift” in management of California’s living marine resources. It was passed at a time of great change in marine management at the federal level and in other states as well as in California. As in other places, California’s MLMA required improved science, wider constituent involvement, and regulatory decision-making constrained by limits on short-term harvest intended to ensure long-term sustainability.

Important elements of the MLMA have been successfully implemented. The Act required the preparation of Status Reports about marine resources, a Master Plan, and two Fisheries Management Plans (FMPs) for specific species (white sea bass and the near shore fishery). But after these explicit requirements of the Act were satisfied, momentum slowed. Three state fisheries are managed under FMPs today (the market squid FMP was completed in response to a separate legislative requirement). Development of an FMP for herring has been underway for two years. The Department of Fish and Game (DFG or Department) has requested participation from external partners to prepare a Spiny Lobster FMP beginning in 2010 and projects a halibut FMP will be undertaken thereafter.

Only a small number of the more than 100 California fisheries are managed under FMPs and it is likely this situation will continue. While the fisheries managed under FMPs include measures that provide for sustainable fisheries, they are the exception rather than the rule when considered in the context of all fisheries. Moreover, the evidence for precaution in data-poor fisheries managed by the state is uneven and raises questions about the capacity to develop or implement the programs, plans and measures that contribute to long-term sustainability. Measured against its overall goal of sustainable management of fisheries, the MLMA cannot be judged to be successful at this time. Simply stated, there is not enough information available about many species to make a sound judgment that they are managed sustainably.

A central lesson learned from California’s experience with the MLMA is that the Act lacks features necessary to accomplish the changes that it sought. The MLMA has no explicit requirements for the preparation of additional FMPs, gives no assurance of adequate resources to accomplish its goals, provides no sanctions or remedies for failures, and provides only limited new authority to the Department or to the Fish and Game Commission (FGC or Commission). The legislation also failed to provide funding sufficient to accomplish its objectives.

One clear lesson from this evaluation is that the ambitious goals of the MLMA were advanced with little attention to ensuring that the state entities most responsible for success – the Department and the Commission—had sufficient capacity and resources. Moreover, no stakeholder has demonstrated a compelling self-interest in successful long-term implementation of the MLMA. Also troubling is that the economic value of living marine resources is relatively modest, being a small fraction of the value of California agriculture, for example, and a tiny fraction of the state’s overall economy. Absent compelling self-interest by stakeholders or a sizable role in the California economy, it is difficult to sustain policy makers’ commitment to effective policies regarding living marine resources.

Some of the responsibility for remedying the shortcomings of the MLMA, and the system by which the state discharges its responsibilities to protect and preserve ocean resources as a public trust, lies with the Legislature. There is, however, a great deal that the Commission and the Department can do on their own, or with the assistance of the Ocean Protection Council, other state agencies, and even federal agencies. In particular, a clear management plan with explicit objectives based on practical resource constraints would provide a valuable foundation for decision making and evaluation of progress toward sustainability. Clarity regarding actions to be taken over the next few years and expected results both provides a foundation for accountability and can appropriately define expectations of what is possible with current policy tools and resources.

These observations lead to the central recommendation from this lessons learned assessment: the Department and Commission should focus on achieving the goals of sustainability and ecosystem-based management that are central to the MLMA and other policies, using the broad suite of tools already available, including those in the MLMA. These goals already provide the broad legal context within which DFG and the Commission act. The recommendation here is to clearly, publicly state what will be achieved in the next three years (by December 31, 2012), by completing identified actions, subject to evaluation against specified performance measures for these two goals. No such management plan exists now and the Master Plan does not fill that need.

Importantly, Californians express strong support for effective management of marine resources. In 2003, a very large majority (88 percent) of Californians said the condition of oceans and beaches was personally important to them and 60 percent said it was *very* important.¹ This reservoir of public support for effective management of living marine resources has not been tapped to provide needed fiscal, staffing and political support for policies in this arena. Clear, transparent discourse about the progress, and the challenges, of managing living marine resources is the best strategy with which to mobilize public support. Public perception that all is well, or that crises follow crises without effective public action, would be neither accurate nor likely to yield long-term support needed for effective management.

This report is organized in five sections:

1. A framework for understanding how to manage living marine resources
2. Institutional and policy foundation
3. Implementation of the MLMA
4. Information on sustainable use of living marine resources
5. Recommendations

In addition, two appendices address the role of science in the MLMA (Appendix 1) and specific questions posed in the Scope of Work for the project (Appendix 2).

¹ Public Policy Institute of California. *It's a Beach State ... of Mind: Despite Tumultuous Times, California's Golden Coast Still Captures Hearts*. San Francisco. PPIC. November 2003.

The information in the report is taken from the statute and legislative history, California Fish and Game Code, regulations, published reports and documents, and interviews with persons who had direct experience with MLMA enactment and implementation.

Consistent with the overall project approach, this document is intended for public review and comment. The project team expects that it will stimulate constructive thinking and public discussion about MLMA challenges, lessons learned, and possible solutions. The project team looks forward to reviewing this input in preparing a final report. An earlier draft was reviewed by staff for the Department, Commission, and OPC; this current draft does not represent the views or policy positions of those agencies and has not been endorsed by them.

The recommendations made in the report are listed below in Figure A, along with information about which public entity should initiate action and proposals for possible new legislative authority. In most cases, it appears that sufficient basis exists to act on the recommendation, but that some “clean up” or further elaboration of legal authority may be needed in the future. This summary is provided as an overview and should be understood, considered, and acted upon in the context of the full analyses and discussion of this report.

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Figure A: Summary list of recommendations and identification of responsible public entities

Number	Recommendation	Public entity which initiates	Possible need for new legislation
1	Develop an effective management plan for living marine resources, considering the MLMA as one tool among those available.	DFG and FGC	Over long-term, "clean-up" of existing law possibly useful but not essential
2	Elevate the importance of information in managing living marine resources, effectively moving toward "Fishery Information and Management Plans."	DFG and FGC	May be required for full effectiveness
3	Establish management processes ensuring that the privilege of harvesting public trust resources carries an obligation to pay for the costs of collecting data and the management actions required to support sustainable management.	DFG and FGC	Appears consistent with MLMA
4	The Legislature should transfer full authority for interpretation of marine fishery management legislation and management of state fisheries to the FGC [and DFG] or other policy making body see Recommendation 5 below. The Legislature should not hear appeals from individual fishery groups, either recreational or commercial, for legislation to "fix" their specific problems.	Legislature	Yes
5	Improve the capacity of the Commission and focus its work on broader policy and management roles and away from individual resource user actions.	FGC	Selected items recommended for consideration in this report
6	Redirect resources devoted to individual fishing permit issues.	DFG and FGC	Possible need if clear barriers are identified
7	Convert to electronic record keeping for all fisheries data.	DFG	Possible need if clear barriers are identified
8	DFG and the FGC should clearly articulate policy regarding MPAs and fisheries.	FGC and DFG	Possible need but current laws appear to offer reasonable foundation
9	Set a clear timetable and specify the resources necessary to gather Essential Fishery Information (EFI). Define preferred stock assessment model(s) and link	DFG	Not at this time

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Number	Recommendation	Public entity which initiates	Possible need for new legislation
	EFI needs to data required to implement the stock assessment model so that management needs are met in an efficient manner. Link this work to the management plan described in Recommendation 1.		
10	Clarify the Ecosystem Based Management model and how it relates to EFI, habitat protection/restoration, and fishery management. Some basic ecosystem thinking could be incorporated into FMPs and all fisheries management actions during routine status reporting, such as food web diagrams to identify predator prey relationships, which may impact other fisheries, and any known relationships between ocean climate cycles and species productivity that may impact future yields.	DFG	Not at this time
11	Continue the policy of peer review of FMPs and other important management actions. Experience from past peer reviews should be used to streamline the process to ensure the most efficient use of both reviewers' and DFG staff time. The CALFED science program established a process that has worked reasonably well and DFG could use experience from this program to help improve its own peer review process.	DFG	Not at this time
12	DFG needs to regain some of its lost stature as an organization that runs on a foundation of good science as this will enhance its credibility as a management organization.	DFG, possibly with support of OPC	Possible need for resources
13	DFG (in collaboration with the OPC and the FGC) should organize a series of workshops offered by academics and practitioners knowledgeable about effectively incorporating science and information and new policy tools into fisheries management. Existing approaches in California (e.g., CALFED Science Program and Independent Science Program, MPA Monitoring Enterprise) should be examined for lessons. Personnel at all levels within DFG, the FGC and OPC should be encouraged to participate in these workshops.	DFG, FGC, and OPC	Not at this time
14	Fisheries management actions should identify quantitative and conceptual models that underlie management now and in the future. These models should be used to structure the research program to ensure that the needs of assessment and, ultimately, ecosystem models are satisfied in an efficient way.	DFG, possibly with support of OPC	Not at this time

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Number	Recommendation	Public entity which initiates	Possible need for new legislation
15	Fishery management actions should include explicit consideration of how the broad range of habitat alterations that human activities cause in coastal waters (including estuaries and coastal marshes) are likely to impact productivity of commercial and recreational fisheries and offer ways to mitigate those impacts.	OPC could take lead on this broad question, working with DFG	Not at this time
16	DFG should establish a technical advisory committee and initiate a series of workshops to assess the implications of both cyclical and long-term changes in ocean conditions on California fish stocks and how knowledge of these effects could be incorporated into management. CalCOFI could be a good framework for assembling such a series of workshops, because it has long been a focus for the analysis of ocean climate variation and its effect on the marine biota of California. The CalCOFI Symposium in 2009 addresses "Forecasting Fishery Productivity in the California Current," which could be an excellent starting point for workshops.	DFG	Possibly needed to provide resources
17	Successful co-management of fisheries requires a high degree of trust and respect between fishers and managers. At present the necessary trust and respect appears to be lacking in most fisheries. DFG should take the initiative to develop pilot projects in collaborative data gathering and other aspects of fishery management with willing fishers as a step toward developing the necessary trust and respect.	DFG	Possible future need
18	The OPC, in consultation with the Ocean Trust, the FGC, DFG, and the Science Advisory Team of the MLPA, should establish a committee to initiate the process of developing a comprehensive research strategy for the California Current Large Marine Ecosystem. The strategy should engage with the marine research infrastructure in Oregon and Washington to develop an inclusive research program as envisioned in the WCGA.	OPC, with FGC and DFG	Not at this time
19	DFG should convene an advisory committee of social scientists, including economists and social anthropologists, to develop a strategy and a plan for defining essential socioeconomic information and how it can be used in management of fisheries. This should be done within the context of continuing budget constraints and the role that social and economic considerations are expected to play in sustainable fisheries. An initial workshop might be followed up by a pilot project (funded through Sea Grant or other appropriate mechanism) to test the ultimate cost and usefulness of socioeconomic EFI in fishery management.	DFG, with possible support of OPC	Possibly needed to ensure resources

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Credits for cover photographs:

Lobster pull: Matt Kay and Sam Shrout, taken at Santa Rosa Island

Blue rockfish in kelp: Curt Degler, taken at Bluefish Cove, Point Lobos

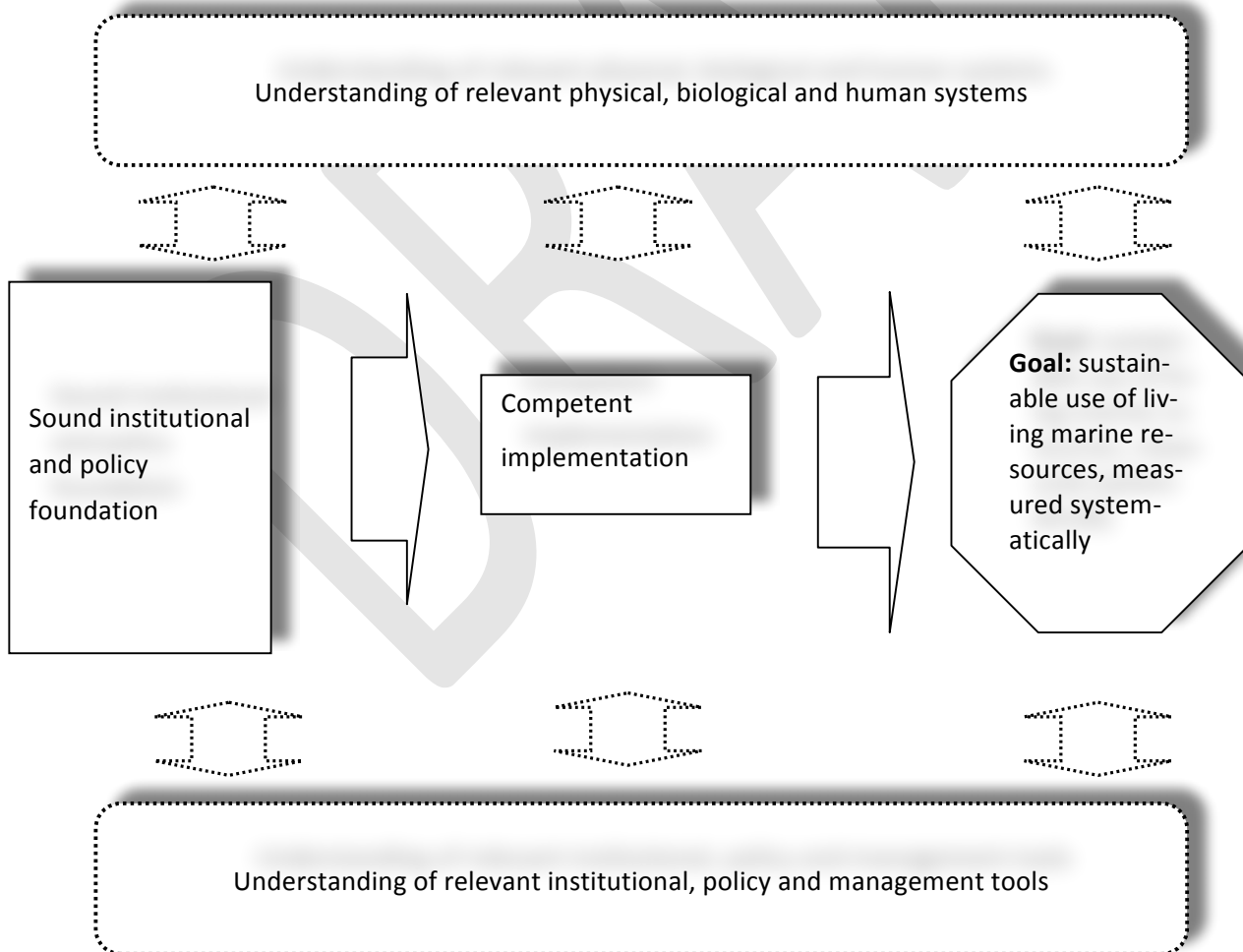
Sheephead: Ben Troxell, taken at Channel Island

A Framework for Understanding how to Manage Living Marine Resources

Managing living marine resources is difficult. The underlying natural systems are complex and changing. The responsibility for managing marine resources is fragmented among many agencies, which operate in multiple policy arenas. Stakeholders – recreational fishermen, commercial fishermen, boaters, SCUBA divers, environmental groups, ordinary citizens and many others often have an active interest in a narrow range of marine resources: a specific species, location, or use of the ocean. Sometimes these interests are in conflict, with some users wanting to harvest a resource while others preferring to minimize extractive uses.

Policy makers and managers will benefit from an effective, simple framework within which to understand their work. Such a framework can also inform interactions with legislators, the governor, stakeholders and interested parties. Figure 1 shows the elements of such a framework.

Figure 1. Framework for effective management of living marine resources



The MLMA, together with other legislation, establishes a management goal: sustainable use of living marine resources, shown on the center-right of Figure 1. A clear goal is critical to effective policy implementation. If there is no agreement about the goal, any policy usually succeeds in doing something of value to some interest group and fails by not meeting the expectations of others. It is critical to measure systematically the progress towards the goal. Success can motivate additional effort. Failure can be analyzed and provide insights into needed changes in institutions, policies or implementation activities.

At the core of this framework – to the left of the goal – are two factors that policy makers and managers can control to some degree: (1) institutions and policies, and (2) the capacity for implementing policies. Institutions and policies should be “sound,” meaning that they are designed to achieve desired goals in most foreseeable conditions. Implementation should be “competent,” meaning that agencies have the capacity to execute policies effectively.²

As explained in more detail below, the MLMA defines the responsibilities of key agencies and sets policy goals and procedures, but it pays little attention to ensuring that these institutions have the capacity required for effective implementation of these policies. As a result of this weakness in institutional design, specific initial milestones required by the MLMA have been completed, but the extensive development of Fishery Management Plans (FMPs) anticipated by some to result from passage of the MLMA has not occurred.

Above and below these three elements are two additional areas warranting attention and action: (1) understanding of relevant physical and human systems and (2) understanding of relevant institutional, policy and management tools. These areas are “outside” in the sense that information is developed and shared not only by state agencies and legislators but also by other players – fishermen, scientists, and others. The system can operate effectively only if agencies can work smoothly with the institutions and individuals who do not have formal responsibilities for putting policies in place and making them work.³

For example, the understanding of life cycles of rock fish or of the effects of human settlement near coasts is relevant to sustainable use of living marine resources, but that understanding develops in universities, among stakeholders, and in agencies with other missions, as well as among those directly engaged in this policy arena. Similarly, concepts regarding the importance of effective support for those charged with policy making (such as the Fish and Game Commission) or regarding policies and management approaches which engage user communities in achieving desired policy objectives, developed in several locales and different policy arenas. “Catch shares” proposals are an example of an idea originating outside government agencies – in universities and think tanks – intended to encourage users of natural resources to behave as “owners” with personal stakes in sustainable use. California policy makers need to know about such proposals and be able to assess their usefulness in California.

Figure 2 summarizes the current status of these elements of California’s marine management system. The remainder of this report analyzes lessons learned and offers recommendations linked to these elements. *The key lesson*

² “Competence” in this framework refers broadly to institutional capacity and not to job performance.

³ This is not a unique problem in state resource management. A new report by the Public Policy Institute of California entitled “California Water Myths” identifies a similar challenge facing water policy makers (p.3).

is that California's system for managing living marine resources is currently inadequate: it is hampered by weaknesses that must be addressed to improve prospects for achieving the MLMA goal of long-term sustainability.

Figure 2. Summary overview of California's current capacity for management of living marine resources

Element	Current situation
Sound institutions	Policy making fragmented among legislature, FGC, and federal agencies. FGC has very limited resources available. DFG has multiple, conflicting missions and erratic funding. OPC touches large number of marine resource issues, but has weak linkage to policy making regarding living marine resources. Overall, weak, given challenges in managing public trust resources.
Sound policies	Broad suite of policy tools available, a positive feature. However, few policy tools give affected parties incentives to achieve policy goals. MLMA includes detailed prescriptions as well as broad themes, leading to tension regarding effective implementation. MLMA lacks accountability mechanisms or guidelines for measurement of progress, e.g., bringing 80% of fished species to moderate data status by 2012.
Competent implementation	Challenges inherent in weak institutions, multiple missions, and limited resources. Overall, largely responsive to direct legislative direction with a tendency toward narrowly focused actions. Weak management frameworks for measurement of progress, adaptation, and accountability.
Understanding of relevant physical, biological and human systems	Capabilities to generate information dispersed among DFG, universities, agencies, resource users and others with DFG science capacity relatively limited. Little institutional capacity to organize available information to effectively support policy making and resource management.
Understanding of relevant institutional, policy and management tools	Capabilities to generate information dispersed among universities, agencies, resource users and others, which is appropriate. No systematic attention within California public agencies to bringing this information into policy making and management.
Sustainable use of living marine resources, measured systematically	Understanding progress toward sustainability limited by lack of systematic assessment or evaluation of the status of many species.

Institutional and Policy Foundation

This section first examines fragmentation of policy making and management capacity and then turns to budget and personnel resources available to the Department of Fish and Game (DFG or Department) and the Fish and Game Commission (FGC or Commission).

Fragmented institutions and multiple policies

Management of California's living marine resources is fragmented and complex. Ocean resources are considered public trust resources and are open to access by all citizens.⁴ States grant the public the right to fish, but have a duty to protect and preserve ocean resources.⁵ Management of marine fisheries in the United States involves three basic jurisdictions: federal, state, and international. Because fish populations often overlap jurisdictions, management is shared among states, between the federal government and the states, or between the federal government and other countries through bilateral or multilateral agreements. For example, vessels fishing for tuna in the deep ocean off California's coast may be governed by an international agreement administered by the Inter-American Tropical Tuna Commission. Vessels targeting herring or sardines beyond state waters are governed by federal regulations. Nearshore fisheries like squid and crab may come under state or federal regulation, while inshore shellfish harvest is entirely under state regulation.

The institutional structure of fisheries management was complex before passage of the MLMA in 1998, was not made simpler by that Act,⁶ and remains very complex. The challenges of sorting out authorities of the Commission, the Department, and the Legislature are significant and are further complicated by the authority of the State in relation to that of the federal government. Figure 3 illustrates this complexity. It shows the most important state and federal policy actions affecting fisheries in state waters since the 1990s, alongside key points in the passage and implementation of the MLMA. At almost every key decision point for the MLMA, a federal agency or another state agency was taking action that was integrally connected with the Department's implementation of the MLMA.

⁴ See, e.g., *Martin v. Waddell's Lessee* 41 U.S. 367 (1842) which affirmed the public's right in fisheries resources. *People v. Weeren*, (1980) 26 Cal.3d 654, 661 applies California law to marine waters. *Arnold v. Mundy*, 6 N.J. L. 1 (N.J. 1821), a New Jersey case is illustrative of other states similar approaches, where the court found a landowner may not stop others from gathering oysters. For treatment of public trust, see *Audubon* 33 Cal.3d 419, 658 P.2d 709 (1983) a case which required preservation of inland fisheries resources on public trust grounds. A general review of public trust, coastal states and fishery management, is available in *Ocean and Coastal Law and Policy*, American Bar Association 2007, at 52-53.

⁵ Coastal States Organization, "Putting the Public Trust Doctrine to Work: the Application of the Public Trust Doctrine to the Management of the Lands, Waters, and Living Resources of the Coastal States," [2d ed. 1997] at 17-18.

⁶ See the Master Plan flow chart in Figure 4 below (p. 17) for a visual depiction of a multiyear process to adopt a FMP. This figure is being reviewed with input from DFG and FGC staff and a revised version will appear in the final report for this project.

Figure 3: Timeline of fisheries related events, 1990s-present

California		Federal	
MLMA Events	Other		
	<ul style="list-style-type: none"> Limited access in various fisheries prior to 1994-95 	1994-95	<ul style="list-style-type: none"> SALMON DISASTER DECLARATIONS: U.S. Dept. of Commerce declares federal fishery disaster, enabling release of emergency disaster relief assistance. 5/26/1994 FR doc 94-22078 (Sept. 2, 1994); Aug. 2, 1995; 61 Fed Reg. 17879-17881 (April 23, 1996)
		1996	<ul style="list-style-type: none"> MAJOR REFORMS: Passage of Sustainable Fisheries Act. Reauthorization of Magnuson Fishery Conservation and Management Act. 96 Pub. L. 561, 94 Stat. 3275
<ul style="list-style-type: none"> Abalone closure 		1997	<ul style="list-style-type: none"> California salmon listed as endangered/threatened (62 Fed. Reg. 3308 (Jun. 18, 1997))
<ul style="list-style-type: none"> Legislature passes MLMA AB1241 		1998	
	<ul style="list-style-type: none"> Legislature passes MLPA FGC Policy on Restricted Access 	1999	
		2000	<ul style="list-style-type: none"> PACIFIC GROUND FISH DISASTER: Declaration of federal fishery disaster in west coast groundfish. The Secretary of Commerce announced the determination of a commercial fishery failure on January 19, 2000.
<ul style="list-style-type: none"> First Status of fisheries published as California's Living Marine Resources: A status report Master Plan 		2001	
<ul style="list-style-type: none"> White Seabass FMP Nearshore FMP 	<ul style="list-style-type: none"> Channel Islands Marine Protected Areas adopted 	2002	
<ul style="list-style-type: none"> Status report updated with additional species 		2003	
<ul style="list-style-type: none"> Market squid FMP adopted 2004 	<ul style="list-style-type: none"> Ocean Protection Council created. Public Resources Code 35600-35625 	2004	
	<ul style="list-style-type: none"> ARMP adopted 	2005	
<ul style="list-style-type: none"> Status Updates & State of Fisheries 		2006	<ul style="list-style-type: none"> Magnuson Stevens Reauthorization Act: California, Oregon and Washington delegated authority to manage Dungeness crab. 104 Pub. L. 208
	<ul style="list-style-type: none"> Central Coast MLPA package adopted 	2007	
<ul style="list-style-type: none"> MLMA Lite (AB 2532) Vetoed 	<ul style="list-style-type: none"> Dungeness Crab Task Force (SB 1690) created by Legislature, August 2008. 	2008	<ul style="list-style-type: none"> Secretary of Commerce announces Salmon disaster declaration November 2008, continued in 2009
		2009	<ul style="list-style-type: none"> Amendments to WC groundfish plan by PFMC; stocks rebuilding; quota program adopted. 74 Fed Reg 9874 (March 6, 2009)

The MLMA captured the prevailing philosophical direction in analyses of fisheries management at the time of its passage. It is beyond dispute that fishery management is changing within and outside California, and this should be acknowledged and even celebrated. Key changes in California since the MLMA include a greater emphasis on data-driven decision making and science, some evidence of precaution in management, a greater appreciation for the contributions of fishery participants and others to management, development of fishery management plans (FMPs) required by the legislation, development of a Master Plan, and improved reporting on the status of the state's fisheries. While difficult to measure according to a single yardstick, interviews suggest these changes are clearly linked to passage and implementation of the MLMA. That said, these changes represent a beginning phase also characterized by increased appreciation of what is not in the MLMA, including clear direction about how to address the basic lack of Essential Fish Information (EFI) for most of the state's fisheries.

The MLMA is generally consistent with federal fisheries policy in its focus on sustainability, data-based and scientifically informed decision making, and increased engagement with constituents and the public. Federal-state interactions appear to support effective marine policy integration and resource stewardship.

Passage and Implementation of California's Marine Life Management Act, released earlier in this project⁷, describes the complex relationship between federal law, primarily the 1996 Sustainable Fisheries Act (SFA), and the MLMA. On balance it appears the MLMA is consistent with the core goals and objectives of the SFA, including 2006 amendments aimed at reducing bycatch. A number of California's high-value fisheries are managed either wholly or partially under the SFA. California appears to benefit from stock assessments and other data-gathering and analysis conducted with federal resources, and the Pacific Fishery Management Council, or PFMC, provides one forum for public engagement that is consistent with MLMA objectives. According to interviews, the PFMC, like California, has made very little progress toward effectively integrating ecosystem-based management, or EBM, into its management approach, which remains tilted toward harvest and single-species analysis. Nonetheless, California derives benefits from the federal fisheries management framework, particularly from federal resources devoted to data-gathering that can assist in improving EFI.

In the context of fragmented institutional arenas and multiple existing approaches to managing fisheries, putting the MLMA philosophy into operation has been challenging for DFG, the FGC, fishery participants, and others interested in marine resource use and conservation. Common to most state regulation, developing a FMP involves multiple steps, shown in Figure 4. Also common to state regulatory processes, formal action by the Commission and then the Office of Administrative Law are controlled by statute as to form and schedule. The MLMA influences steps leading up to formal Commission action on FMPs, e.g., in the design of the policy, use of science, and stakeholder involvement, and in implementation phases.

Both the Commission and Legislature are attractive forums for interests seeking to influence fisheries management in California. The Commission can influence FMP development preceding formal adoption and during

⁷ Marine Live Management Act Lessons Learned. *Passage and Implementation of California's Marine Life Management Act*. July 15, 2009. http://www.opc.ca.gov/webmaster/ftp/project_pages/mlmall/T1_draft

implementation through interaction with the Department, stakeholders and the public at its meetings. The Legislature can affect these processes in a variety of ways, including budget allocations, control language included in budget bills, oversight hearings, and new or amended statutes. Consistent with experience of such bodies in any area of public policy, interests affected by fisheries policies frequently seek relief from one or another dimension of the policies or some change that advances their perspective on how the policy should be structured or implemented. As a consequence, marine resources policy development in California often appears to be driven by legislative influence focused on single “problems” and not by the science-based approach mandated in the MLMA when the legislature looked at issues more broadly. The legislatively created Dungeness Crab Task Force is the latest example of a single, high-value fishery forcing a shift in Marine Region priorities, with inevitable impacts on overall staffing and resources. DFG management reportedly sought in late 2009 to limit staff work supporting the Dungeness Crab Task Force by limiting its participation between formal meetings to occasions responsive to formal OPC requests for data.⁸

Table 1 illustrates the resulting fragmentation in policy making patterns. It shows that MLMA-based FMPs are used to manage only three fisheries – white seabass, market squid, and 19 near-shore species. All other species in the top 20, ranked by commercial landed value, are managed directly by the Legislature or the Commission or by the federal PFMC. The implementation of these policies – the day to day management – falls largely to the Department.

The MLMA was designed to provide the foundation for all state management of living marine resources, but the fragmented structure of marine management and political pressures from narrowly focused stakeholder interests have prevented progress toward the kind of ecosystem-based management that the MLMA directs. Accordingly, top DFG staff must spend a large portion of their management time working through the PFMC or with the Legislature and the Commission rather than primarily through MLMA-based FMPs.

The causes of this fragmentation can be traced back, in large measure, to the MLMA itself. The statute directs the Department and the Commission to adopt a multi-species, ecosystem-based approach for management of living marine resources, but the law does not include any deadlines, penalties, or other requirements that would force action that complies with MLMA goals. The statute also has limited practical scope, because it leaves in place most existing management policies and effectively exempts many fisheries from its provisions, including those managed by the Legislature. While the FGC can develop an FMP for legislatively managed species, doing so requires legislative approval.

Effective policy implementation depends on specific requirements, powers conferred, resources available, and remedies provided. The changes in legislative language as the MLMA was enacted resulted in a statute with limited explicit requirements, limited powers, no continuing provision of resources, and no remedies for failure to act. While the intent of the original AB 1241 could understandably be characterized as dramatically changing policies on use of

⁸ In 2009 the Legislature enacted AB 571 (Saldana), a program focused on a single commercial fishery: lobster. The bill was vetoed by the Governor. The veto message cited three concerns:

1. Increasing the cost of a commercial permit by almost 90%
2. The risk of driving some permittees out of the fishery due to increased costs, and
3. Imposing new mandates and obligations on DFG without adequate funding.

These concerns merit re-consideration in light of recommendations discussed later in this report.

California ocean resources, the MLMA as enacted was narrower in its aspirations. At least as importantly, some of the provisions of AB 1241 intended to achieve more effective policy making, such as establishing a “Marine Life Management Commission” with significant regulatory authority, or explicitly requiring use of a precautionary approach to manage fisheries, were removed before passage of the bill.⁹

As enacted, the tools the Department may use to meet the goals of MLMA are, at least arguably, discretionary. For example, the MLMA provides discretion to the Department in how and to what extent it conducts collaborative science, designs dispute resolution, promotes co-management, secures peer review, develops FMPs, identifies non-fishing sources of depressed fisheries, evaluates the management system, specifies measures to achieve sustainability, chooses the approach to manage emerging fisheries, and imposes fees. Additional flexibility has been provided by amendments to the statute that extended deadlines for completion of mandatory elements.

While the Master Plan required by the MLMA specifies steps and processes for implementation, it ultimately can be no more forceful than the underlying statute.¹⁰ And it is unrealistic to believe that the existence of any statute or planning document will easily alter the expression of stakeholder self-interest in policy processes.

⁹ See *Passage and Implementation of California’s Marine Life Management Act* pages 18-26 for discussion of provisions included at passage of the Marine Life Management Act.

¹⁰ The Master Plan is not an effective *management plan*, although it is an important tool.

Figure 4: The FMP Development Process

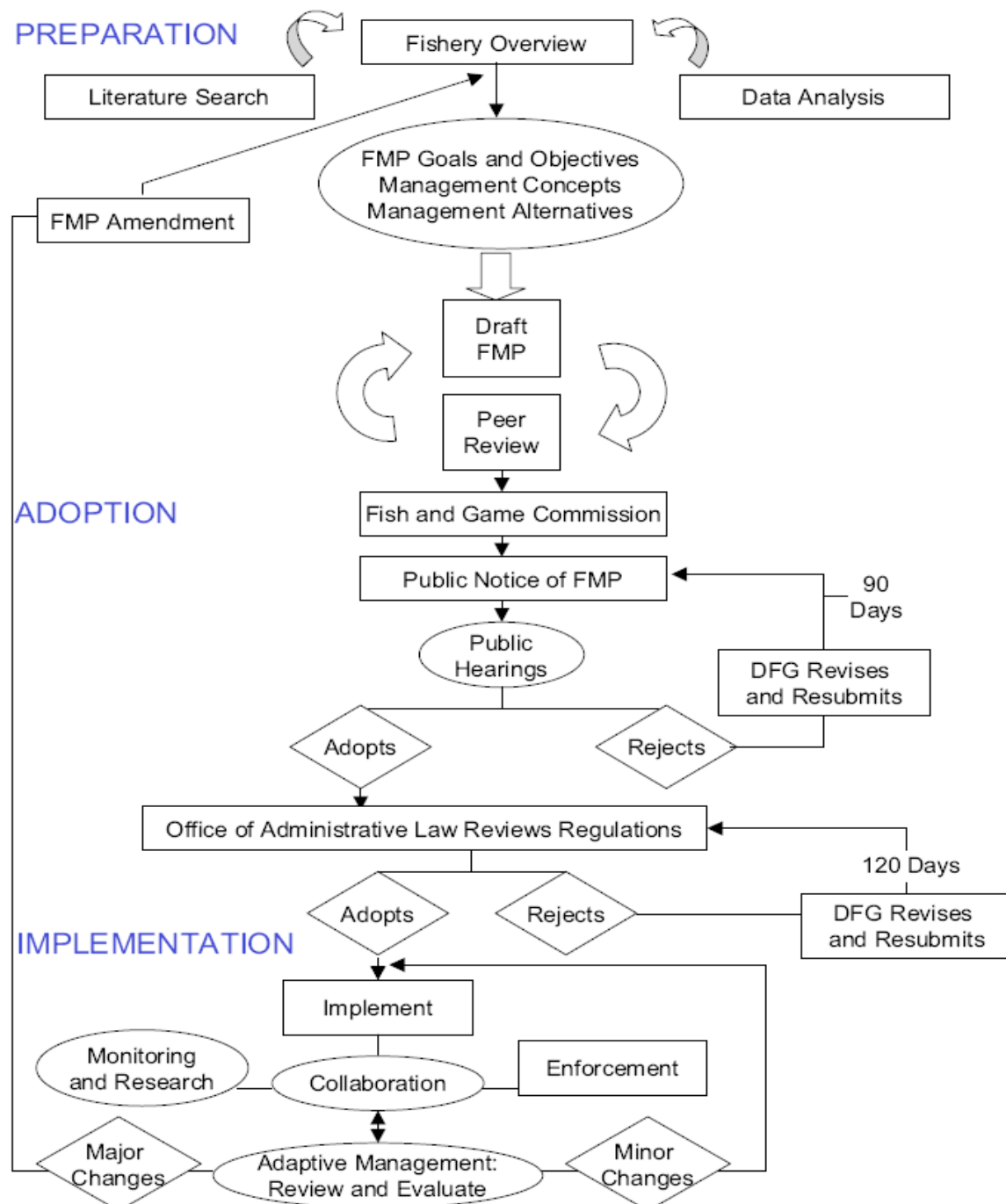


Figure 2-1. Diagram of fishery management plan (FMP) preparation, adoption, and implementation stages.
DFG = Department of Fish and Game

Source for diagram: Master Plan. A revised version of this figure is being developed for the final project report with assistance from DFG and FGC.

Table 1: Management of California Commercial Fisheries

Fishery	Major management policies in place (date)	Rank by commercial landed value, in dollars, 2007	Rank by commercial landed value, 2007	Rank by commercial landing weight, 2007
White sea bass	MLMA FMP (2002)	\$1,154,017	16	24
Near shore	MLMA FMP (2002)	\$2,424,836		
Squid	MLMA FMP (2004); restricted access (2005)	\$29,093,312	1	2
Abalone	Recovery and management plan (2005)	\$0		na
Crab, Dungeness	CA legislature. Vessel-based restricted access (1992)	\$26,892,110	2	6
Sardine, Pacific	PFMC. Limited entry (1999) ; capacity goal (2003)	\$8,218,158	3	1
Salmon, Chinook	CA legislature, PFMC; Restricted access (1983)	\$7,835,240	4	12
Lobster, CA spiny	CA legislature, PFMC; Restricted access (1997)	\$6,915,601	5	21
Sea urchins	FGC. Restricted access (1989). Effort reduction (1990)	\$5,400,279	6	4
Sablefish	PFMC; FGC	\$4,872,745	7	9
Swordfish	PFMC; FGC	\$3,126,635	8	18
Prawn, spot	FGC	\$2,879,716	9	34
Sole, Dover	PFMC; FGC	\$2,376,031	10	7
Sole, Petrale	PFMC; FGC	\$2,122,196	11	10
Anchovy, northern	PFMC. Limited entry (1999) ; capacity goal (2003)	\$1,103,299	17	3
Mackerel, Chub	PFMC. Limited entry (1999) ; capacity goal (2003)	\$788,915	20	5
Hake, Pacific (Whiting)	PFMC; FGC	\$386,216	24	8
Herring	FGC. Sac-rope fishery limited access (1983)	\$149,073	41	16

Sources: Commercial landed value and weight from the National Ocean Economics Program

Notes: No commercial take of abalone. Value for herring includes Pacific Herring and roe on kelp. Value of near shore species under NFMP is sum of 16 (of 19) species identified in National Ocean Economics Program data for 2007. Total weight was 533,321 pounds. Not included in ranks for value or weight as other entries are for single species.

Lessons Learned

1. The MLMA has helped to foster broader understanding and observance of science-based, ecosystem-oriented, multi-species approaches to management of living marine resources. But the MLMA is not the sole force pushing for this way of doing business: other state legislation and federal law and policy are also significant factors.
2. Authority for making decisions about management of living marine resources in California remains fragmented. This fragmentation perpetuates single-species legislation, policy making, and management at odds with MLMA goals. It is disruptive of the science-based decision making intended to lead to FMPs based on prioritization. As long as this is the case, consistent policy making that promotes MLMA goals will be difficult to achieve.
3. The MLMA's lack of mechanisms for measurement of progress and accountability has contributed to a slowing of momentum and lack of progress in achieving core goals. The absence of such mechanisms leaves MLMA implementation as a discretionary set of choices for DFG and the FGC. The absence of a clear management plan for MLMA implementation further contributes to external frustration over accountability and implementation priorities.

Capacity for Managing California's Living Marine Resources

Budgets and human resources are critical components of capacity for managing living marine resources.

Budget and personnel

The extent and character of financial and human resources available to the Department generally, and the Marine Region specifically, are important to understanding implementation of the MLMA. Implementation of resources policies and programs requires money and people as surely as does building roads, regulating banks, or running school systems. In fisheries management, as with any other policy area, it is sensible to secure money and people sufficient to achieve desired policy goals, but not sensible to waste such resources.

The primary responsibility for implementing the MLMA lies with the Marine Region of DFG. The Commission also gained new responsibilities in the MLMA: approving FMPs, requesting and receiving reports from the Department, and providing guidance in implementation of fisheries management policies. While not having oversight powers in relationship to the Department, the Commission's exercise of their regulatory powers has great impact on the Department, users of marine resources, and the public. The Commission also has a very large work load associated with issuance of individual licenses and permits (e.g., for commercial fishing vessels or for limited entry fisheries) and subsequent enforcement actions, requests for transfers of permits and licenses, and other actions.

The current budget of the Marine Region is \$18.239 million (FY 2009-10). Perhaps the best way to put this figure in context is to compare it to size of the California's commercial fisheries and to total expenditures for

recreational marine fishing. The total Marine Region budget was approximately 15 percent of the value of commercial fishery landings in 2007 and slightly less than 5 percent of the combined commercial landing values and midpoint estimate of expenditures on recreational marine fishing of \$205 to \$545 million annually. As shown below in discussion of budgets and resources, MLMA implementation receives less than 20 percent of the total Marine Region budget, so funds for this program are a modest fraction of the value of commercial and recreational fishing.

Still, the size of recreational and commercial fishing industries in the California economy is relevant to both the attention likely to be received by policy makers and the comparative resources available for policy making and policy implementation. While of great importance to direct users, and valued broadly by Californians, commercial and recreation fishing are a small part of California's economy, as illustrated in Table 2 below. In summary:

- Commercial and recreational fishing are roughly equivalent in economic value to hunting or timber harvest
- Total cash income from California farming is much greater, perhaps 80 times larger, than income from harvest of marine resources¹¹
- Totaled together, direct uses of natural resources (fishing, hunting and timber harvest) and farming are small fractions of the total California economy

¹¹ Any sector has greater economic impact than cash income or expenditures (usually analyzed as "multiplier effects"), but these data are useful to identify relative levels of economic activity.

Table 2.

Economic value of California commercial and recreational fishing in context

Annual values

Total landed value of all California commercial fisheries, 2007	\$120.2 million ¹²
Expenditures for marine recreational fishing, early 2000s	\$205 million to \$545 million ¹³
Retail sales associated with hunting in California, 2001	\$526 million ¹⁴
Total value of timber harvest, 2007	\$474 million ¹⁵
Total cash income from California farming	\$39,000 million ¹⁶
California state gross domestic product, 2007	\$1,800,000 million ¹⁷

Obviously, this information does not address whether the DFG budget is sufficient to meet the responsibilities of the Marine Region. It does, however, provide a context in which to understand the prospects for increases in funding. Moreover, the public character of living marine resources means that there are limited incentives for private users to invest in managing these resources more sustainably. Some management tools could possibly address this second challenge. As an example, catch shares do not change the public character of a resource but create “owners” of the rights to access the resource.¹⁸ Whatever the success of policies designed to influence use patterns of public resources, the total economic value of living marine resources as a portion of the broader economy is harder to change.

Furthermore, California’s current fiscal problems constrain the prospects for more spending on managing living marine resources. State government budgets are being cut and personnel are being put on furloughs. Deficits are significant and are projected to grow for several years.¹⁹ General fund allocations have been an irregular source of revenues in the past and are likely to remain so for the foreseeable future. While fees have been important sources of funding for DFG, there is often resistance to fees among users unless direct benefits are seen through dedication to

¹² National Ocean Economics Program. *Commercial Living Marine Species in California*, 2007.

¹³ Woods Hole Oceanographic Institute. *An Inventory of California Coastal Economic Sectors*. <http://www.whoi.edu/mpcweb/research/NOPP/California%20region%20progress%20report%20Jan03.pdf> See also: Linwood H. Pendleton and Jamie Rooke. *Understanding the Potential Economic Impact of Marine Recreational Fishing: California*. <http://www.dfg.ca.gov/MLPA/pdfs/binder3di.pdf>. Accessed October 19, 2009.

¹⁴ International Association of Fish and Wildlife Agencies. *Economic Importance of Hunting in America*. 2002. Page 8.

¹⁵ California State Board of Equalization. *California Timber Harvest Statistics*.

¹⁶ California Department of Food and Agriculture. *California Agricultural Resource Directory, 2008-2009*. Page 23

¹⁷ California State Department of Finance. *California Statistical Abstract*. January 2009. Table D-1.

¹⁸ State management of rights to use fresh water resources is an example of a similar, but not identical, public resource framework.

¹⁹ http://www.lao.ca.gov/2009/bud/feb_overview/feb_overview_031309.pdf.

specific purposes valued by fee payers. In any case, the limited total economic value of commercial and recreational fishing also imposes limits on feasible fee revenues.

The Marine Region is just one of seven DFG regions whose broad mission encompasses much more than managing marine resources. Though important historically, fishery management is just one part of the responsibilities in the Marine Region, which also has pollution prevention, aquaculture, and bay management among other responsibilities. The MLMA imposed significant new responsibilities on DFG and the Commission without establishing a reliable, dedicated source of funding to support those responsibilities. When the law was passed, the Marine Region received its first general fund appropriation in 1999-2000. And for the first time, commercial fishing programs, according to the Fish and Game Code, were to be financed in part by revenues they generated.²⁰

But funding in recent years has been volatile. As shown in Figure 5,²¹ the largest category of funds for the Department is “other” – mostly bond funds. The second largest category is appropriations from the state General Fund. The third largest, “Fish and Game Preservation Fund,” includes sport fishing and hunting and commercial fishing license revenues and a number of dedicated funds. Examples of marine-related dedicated funds include user stamp fees to fund marine fish species research and recreational abalone management.

The 2006-07 budget of the Department was 23 percent larger than its 2005-06 budget, at least in part reflecting a OPC/DFG joint work plan, with increases in bond funds and some increased fees and reimbursements, but lower general fund appropriations. In 2008-09, the general fund appropriations declined, and allocation from bond funds fell back to 2005-06 levels, resulting in a 26 percent decline in total revenues from 2006-07 and a nine percent decline from 2005-06.

The sources of money for the Marine Region had been commercial fishing licenses, taxes on commercial landings, and permit fees. Recreational fishing programs were also funded by their own revenues. Federal sources such as the Federal Aid in Sport Fish Restoration Act of 1950 (Dingell-Johnson Act) and the Interjurisdictional Fisheries Act of 1986 provided additional revenues for specific activities or as reimbursements.

Table 3 reports the information that is currently available about funding and staffing of the Marine Region and of the MLMA program within the Marine Region. Funding and staff levels rose and fell from year to year similar to the Department as a whole. Overall, MLMA funding and staff declined dramatically in the 2002-2006 period, but have since returned to somewhat greater proportions of Marine Region funds than in the early period shown (14 percent vs. 8 to 13 percent) and a larger proportion of staff (now 17 percent vs. 5 to 10 percent through 2006-2007).

While the Department manages MLMA processes, the Commission is responsible for approving FMPs and fishery-related regulations and handling appeals of permits and revocations. The Commission does not have a separate budget and only recently was identified as a “program” in the Department’s budget. In 2009-2010, the Commission was budgeted for \$1.379 million and was authorized for 7.8 personnel years.

²⁰ FGC §711

²¹ Department, *Budget Fact Book*. January 10, 2008

Figure 5.

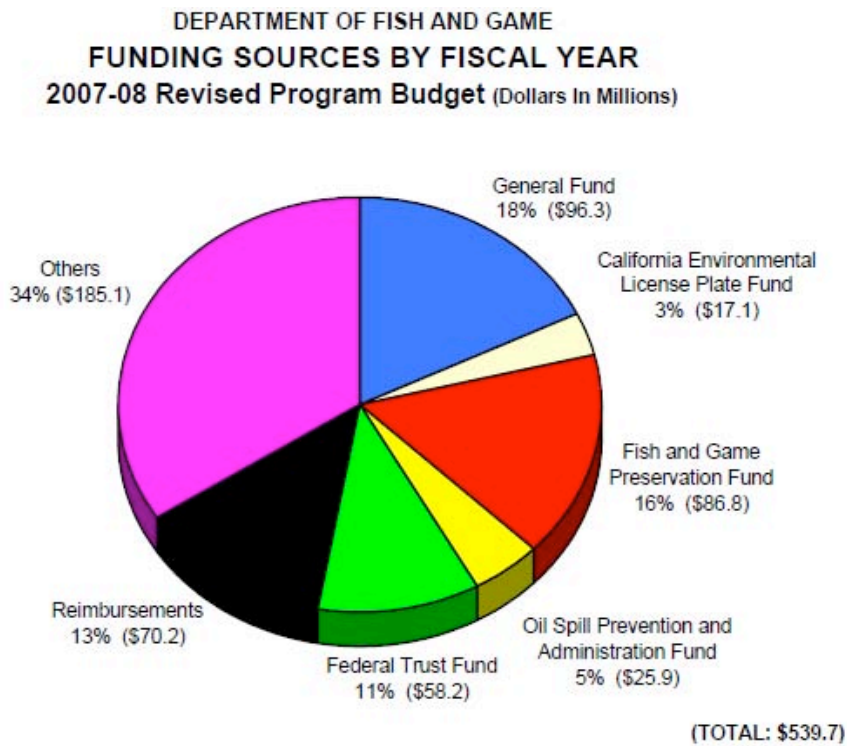


Table 3. Budget and staff working on marine issues in the Department of Fish and Game

Fiscal Year	Total Marine Region Budget	Total MLMA Funding	Total Marine Region Staff	MLMA staff
1999-2000*	\$20,832,808	\$2,800,000	203	10
2000-2001*	\$24,535,104	\$2,100,000	213	11
2001-2002*	\$23,681,557	\$2,400,000	213	11
2002-2003*	\$20,114,107	\$2,400,000	197	12
2003-2004*	\$18,337,137	\$900,000	173	9
2004-2005	\$15,008,906	\$829,000	116	9
2005-2006	\$14,114,226	\$900,000	114	9
2006-2007	\$23,041,932	\$3,235,000	152	15
2007-2008	\$21,308,874	\$3,055,000	153	26
2008-2009	\$18,379,000	\$2,655,000	148	26
2009-2010	\$18,239,000	\$2,655,000	154	26

Notes:

1. In fiscal years 1999-2000 through 2003-2004, enforcement staff is included in Marine Region staff total.
2. For these respective years, enforcement staff totaled 37, 46, 55, 53, and 50 positions.
3. Technical staff, including biologists, environmental scientists, economists, statisticians, GIS and managers is 70-75 percent of total marine region staff in the last four years.

Source: Data provided by Marine Region for this report.

In summary, examination of the comparative economic value of marine fishing in the California economy and the budgets and personnel available to the Department and Commission is sobering for those interested in and working in this important policy arena. *Budgets and personnel provided are modest and highly variable. There is little prospect for substantial increases and no evident way to reduce cyclical fluctuations in available budgets and personnel under current law.*

With a limited and shrinking resource base, the Department has been struggling to meet the challenge of the MLMA and other fisheries management actions. The Commission equally struggles in its policy making and regulatory roles. In the years immediately following passage of the MLMA, for example, the Commission was supported by staff paid for with grants from private foundations. DFG staffers interviewed (and quoted anonymously in the “NFMP debriefing” document) noted that mandates, such as the Nearshore FMP (NFMP) and the MLPA, often required DFG staffers to be pulled from other projects, resulting in difficulty in successfully implementing policies and sustaining momentum in programs.

Vision and Strategy

The Marine Region of the Department wrote its first strategic plan in 2000, shortly after passage of the MLMA and the MLPA. In July 2009, it published a new strategic plan in response to “new funding and unprecedented hiring in 2007 “under the joint OPC/DFG work plan (p. 4).” The new strategic plan sets three broad goals that correspond closely to topics addressed in this report:

“Organizational Vitality: administrative functions, employee foundations, and internal communications

Marine Resources Stewardship: adaptive management, scientific capacity and regulatory programs

Public engagement: education, outreach, and collaborative efforts with others.” (p. 7)

The plan is attractive and succinct. Eight pages give brief descriptions of the mission and staffing of 14 specific projects, e.g.: Administrative and License Sales Staff, Marine Fisheries Statistical Unit, Groundfish Project, Marine Protected Areas Project, Project Review Project, and Fishery-Independent – SCUBA Assessment Project. Nine pages outline the implementation process for the three goals. All of the specific commitments are on target. But most commitments either define operational responsibilities, e.g.: “maintain a database of equipment owned by the Marine Region,” or are very general:

“a staff person will develop a description of how to optimize training opportunities”

“selected staff will work with constituents to develop a working definition and model for ecosystem-based management based on scientific and management literature”

“publish reports and the results of research, if appropriate”

“Staff will provide Marine Region partnership guidelines to potential partners”.

There is no indication in the plan that the Department used this opportunity to consult with stakeholders, the Commission, or the Legislature, or to go through common steps of strategic planning, such as assessments of strengths, weaknesses, opportunities, and threats. The plan does not address the specific challenges that are outlined in this report – *data poor* fisheries, budget shortfalls, fragmented institutions, or lack of progress in preparing FMPs. The plan does not set performance targets or deadlines and does not provide for monitoring and evaluation of progress.²² It says simply that every year the Regional Manager will select a high-priority action, assign someone to be Champion, and have her assistant keep track of progress.

Scientific capacity

Historically, DFG was a respected science organization and contributed important new knowledge about fisheries to the scientific literature. This contribution has fallen off considerably as resources have been squeezed. Lack of resources (financial, professional) is often cited as an obstacle to achieving the vision of the MLMA. The data

²² The plan uses five to eight year timeframes, which are too long to guide management actions and are subject to external influences such as the four-year election cycle for governor. These timeframes are more appropriate to measure success against policy goals, such as sustainable use of marine resources.

poor state of most fisheries means that DFG is starting from a very low baseline of information to achieve MLMA goals or effective fisheries management in general.

DFG staff has broad responsibilities: gathering information from fisheries, understanding how fisheries operate, developing regulations, presenting information before the FGC, interacting with constituents, and responding to legislative and FGC needs, among many others. These demands, as well as limitations in expertise, influence the amount of scientific work the Department can realistically hope to carry out. As a result, DFG must utilize scientific information generated from outside: academia, other agencies, contractors, and collaborative efforts with fishermen.

DFG produces much of the routine scientific and statistical data that it uses for management.²³ Probably most important is its role (sometimes in collaboration with other agencies) in gathering and analyzing fisheries-dependent data, which is often the only source of data on abundance trends and is used as input for statistical stock assessments. (Fisheries-dependent data are gathered as part of the fisheries management processes (e.g., catch records). Fisheries-independent data are gathered by research projects not directly associated with fishery management.)

DFG also carries out some fisheries-independent surveys, such as diver surveys to assess abalone abundance in fished and unfished areas. Remotely-operated submersible vehicles (ROVs) are used to assess fish populations in fished and unfished areas as well. Herring populations in San Francisco Bay are estimated by hydro-acoustic surveys and surveys of herring eggs. DFG staffers also conduct research to gather Essential Fishery Information, or EFI, but it is difficult to gauge its extent for this report.

Recently, DFG has instituted a number of programs for improving fishery-dependent data gathering, particularly in the sports fishery, and has been able to assemble data to move a number of finfish species from the *data poor* to data-moderate categories.

However, there is concern that DFG lacks the capacity (personnel and budget) for detailed quantitative data gathering from the majority of fisheries that it manages. There is also concern that, even if detailed quantitative data were available, DFG does not have sufficient trained staff to conduct quantitative stock assessments or to interpret the results of such surveys. The Marine Region currently has a few respected experts in statistics and population dynamics. Hiring processes also make it difficult for DFG to hire and retain the most highly qualified staff according to interviews.

DFG has a history of successfully engaging with academic researchers to fill gaps in EFI and to conduct data analyses. Academia and other research institutions (e.g. CalCOFI) can also address research questions that are beyond current DFG capabilities (e.g. genetic stock identification, large-scale egg and larval surveys). Outside agencies are not likely to be fully committed to DFG priorities, however, as they have their own statutory obligations and missions, so that DFG needs to rebuild and retain a solid in-house capacity for science.

The variability of state funding for DFG discussed above also influences the amount, quality, and continuity of scientific work carried out by DFG. Programs may be initiated during flush times, but terminated or reduced in scope when times are lean.

²³ See, e.g., <http://www.dfg.ca.gov/marine/research.asp>

Lessons Learned

1. Setting aside differences over priorities and methods, the budgets of the Marine Region and the Commission over the past decade have fallen short of basic requirements for achieving significant progress on short- and long-term MLMA goals. These budgets are not likely to increase substantially in the near future, which will require policy makers and managers to focus resources on highest-valued actions and seek ways to leverage available resources. A clear management plan specifying which tasks have priority, with deadlines for work products and allocation of resources, is one tool to support choices that are clearly linked to goals and objectives. Decision making in the absence of such a plan is likely to appear purely discretionary and contribute to frustration and conflict.
2. The MLMA committed the state to an ambitious agenda for improved management of living marine resources and marine ecosystems. However, it will take a significant effort and a rethinking of current approaches for the Department to increase the number of data-rich fisheries and assemble data needed for the management of other living marine resources and adoption of EBM, as required by the MLMA. One challenge is devising approaches that can succeed despite the “interruption” of planned work to respond to new crises or new directives.
3. Decision making based on the best available science is a key to success in resource management but the Department's historic status as a respected science organization has faded. Reasserting this leadership role, perhaps through seeding and leading ambitious collaborative science projects, is needed. OPC may provide future support in this area.
4. Budget is a significant factor that constrains the ability of the Commission to provide meaningful MLMA policy guidance to DFG and well-informed decision making on fisheries management issues. Increasing resources for the FGC should receive high priority if there is an expectation that the Commission will fulfill its MLMA role.
5. The Marine Region updated its Strategic Plan in 2007-09 in response to budget increases in 2007. The plan is a useful initial effort to identify important questions about the Marine Region’s capacity to fulfill its statutory responsibilities. But it falls well short of a working agenda for action. Strategic planning can be an opportunity to reach out to the Commission, the Legislature, fishermen and other stakeholders to develop a shared plan for action, but this has not happened.

Implementation of the MLMA

Discussion of the implementation of the MLMA focuses first on use of the tools provided by the MLMA and then on stakeholder relationships.²⁴

²⁴ Appendix 1 to this report is an issue paper that examines the role of science in the MLMA. Some of the content from that issue paper has been included in the main body of the report, including recommendations.

Using MLMA Tools

The MLMA mandated the preparation of three kinds of documents to guide management of living marine resources:

- Status Reports to describe the health of different fisheries and other resources
- A Master Plan to set priorities for and guide the preparation of Fishery Management Plans
- Fishery Management Plans

As described in the *Passage and Implementation of California's Marine Life Management Act*, there is no doubt that the Department and Commission responded to MLMA directives to develop specific tools and products and use specific processes.²⁵ In particular:

1. DFG prepared an initial Status of Fisheries report in 2001 and updated it for some species in 2003 and 2006.
2. DFG developed a detailed Master Plan in 2001 that was responsive to the MLMA, and did it in a way that engaged external scientists, fishers, and other interested parties.
3. DFG developed, and the FGC adopted, three legislatively directed FMPs, one for white sea ass (WSB FMP, 2002), one for 19 nearshore species (NFMP, 2002) and one for market squid (MSFMP, 2004).

Both DFG and the Commission deserve credit for these accomplishments, which not only responded to the statute in significant ways but promoted the shift in California's approach to fisheries management mandated by the Legislature. There was a significant role for science, peer review was part of the process, DFG engaged outside experts, and there was extensive involvement of fishery participants and other interested stakeholders.

Since that initial burst of activity—and even enthusiasm—there have been no new FMPs. Interviews identified diverse factors, with some external observers perceiving a critical loss of momentum. These different views are addressed below after a discussion of the Master Plan and of the three FMPs that have been completed so far.

Master Plan

The Master Plan is intended to serve as the overarching point of reference for all fisheries managed under the MLMA. It is intended to identify priority species for preparation of FMPs, describe data-gathering activities for marine fisheries and other activities needed to gather EFI, and identify an inclusive process for developing FMPs and research plans. DFG and the Marine Region devoted substantial resources to development of the Master Plan in 2001 and took steps to include constituent and outside scientific perspectives. The Master Plan has not been revised on the schedule

²⁵ DFG management generally interprets the MLMA as a philosophy. See *Passage and Implementation of California's Marine Life Management Act* pp. 23-25.

specified in §7.2 of the plan itself: four years after adoption, and thereafter every four years unless more frequent review is appropriate.²⁶ The Marine Region has committed resources to a revision but it is still under development.

There is conflicting evidence about the impact of the Master Plan since its adoption. The *Passage and Implementation of California's Marine Life Management Act* raises questions about whether it was developed in time to influence the NFMP in any significant way. And there is some evidence that the Master Plan has unintentionally served as a barrier to the development of FMPs due to a perceived lack of flexibility in its interpretation of the MLMA.

Other concerns about the Master Plan are that:

1. The Master Plan does not include a management framework to address lack of EFI. As described in the Master Plan, FMPs are linked directly to the availability of EFI that is lacking for most of the state's fisheries. While there are tools available to manage fisheries, e.g., gear types, bag limits, and restricted access, there is no clear process for precautionary management in the absence of EFI or for data-gathering to improve understanding and better conform to MLMA goals.

2. The Master Plan states that California is committed to and is moving toward EBM but does not specify what this means. FMPs are to include ecosystem guidelines but these are left to be decided in the context of each plan. The WSB FMP and NFMP both mention the importance of ecosystems but lack any framework for management actions or description of the role of EFI.

3. The Master Plan contains a description of adaptive management that is potentially useful, but offers no guidance about how adaptive management could or should be integrated into fishery management.²⁷

4. The Master Plan does not integrate socioeconomic considerations into fishery management.

5. The Master Plan has been interpreted by DFG as presenting a single model for FMP preparation that highlights process detail over flexibility and adaptability. DFG consistently highlights information that "must" be in an FMP based on the Master Plan interpretation of the MLMA.²⁸

Fishery Management Plans

FMPs are at the heart of the MLMA's approach to fisheries management. There have been some disappointments associated with the FMPs that have been adopted so far, as well as some steps toward precautionary management given the lack of EFI.²⁹

The adopted Market Squid FMP was a response to legislative direction and not the Master Plan system of fisheries prioritization. The Commission's process for adopting the Market Squid FMP, and its final content that

²⁶ *Passage and Implementation of California's Marine Life Management Act*, p. 32. The MLMA does not specify a schedule for updating the Master Plan in §7073.

²⁷ See Appendix 1 pp. 2-5

²⁸ Some interviews for this project suggested that concern over possible litigation for taking a different approach contributes to resistance. A foundation for this concern is difficult to ascertain in the MLMA, however, as it does not contain any citizen suit provision.

²⁹ The WSB FMP and NFMP are discussed extensively in *Passage and Implementation of California's Marine Life Management Act*.

eliminated capacity limits, raise questions about whether California truly has shifted from a short-term, harvest-based perspective to a long-term, sustainability perspective.

Developing and implementing the NFMP is estimated by DFG to have cost over \$10 million. Clearly \$10 million for any future FMP is very difficult to accommodate in California's current, and likely future, fiscal environment. It is not clear just how to allocate these cost estimates across different FMP process components, e.g., DFG staff time, data gathering, science, and public engagement. (The Master Plan suggests public engagement is 5% of total costs).

Significant components of the NFMP have not been implemented, undermining its effectiveness. This FMP was destined to be difficult to develop and implement because of the biological, economic, and sociological complexity of the fishery. Regional management and comparison of species dynamics inside and outside marine reserves were key components of the FMP. However, DFG has not implemented regional management, reportedly due to cost concerns, and intended reserve/non-reserve comparisons await establishment and management of MPAs under the Marine Life Protection Act. Relevant data monitoring plans are being developed by the MPA Monitoring Enterprise, funded by OPC, but in cooperation with the DFG. Nearshore fishery management appears to be drifting away from the NFMP vision, while increasing pressure from recreational fisheries is challenging fundamental plan assumptions. In the view of some, the NFMP promised something it could not deliver in the near term and is unlikely to deliver in the next decade. This inability to deliver, and the cost of the plan, has contributed to resistance to doing more FMPs according to interviews with DFG staff.

What fishery management tools are used?

The fact that only three FMPs have been completed, all required specifically by legislation, has been a principal source of frustration about the MLMA's first decade.³⁰ The first decade of management since passage of the MLMA has been characterized primarily by continued use of already existing conventional measures regarding gear, seasons and sizes. Though the conventional measures used to manage many of California's fisheries arguably contribute to sustainability, they do not reflect a consistent and clear commitment to precautionary management in the spirit of the MLMA. In particular, they do not establish reliable catch limits that include a margin for error or uncertainty. Some fisheries remain under *ad hoc* frameworks devised in the Legislature, and are effectively shielded from DFG and FGC management actions under the MLMA. It is notable that the best examples of precautionary management approaches appear to be in those fisheries for which DFG developed FMPs.

Table 4 shows the management tools used in fisheries managed by the state, plus Dungeness crab and halibut, currently managed by the Legislature. Conventional tools remain dominant, and the limited use of annual catch limits merits attention.

³⁰ Another view is that the MLMA has generated only two full FMPs, as the WSB FMP was largely based on a pre-existing plan.

December 14, 2009

Table 4. Management tools used in state-managed fisheries.

Fishery	FMP (or similar)	Abundance estimate	Annual catch limit	Plan to acquire EFI	Management measures	Effort limitations	Restricted Access or Limited Entry
Abalone	Y (ARMP)	Y	Y	Y	Closures, area management	Y	Y
Dungeness crab (legislature manages)	N	Y	N	(Task Force)	Size, sex, season	Not yet	Y
Hagfish	N	N	N	N	Gear restrictions	N	N
Halibut (legislature manages)	N	Stock assess- ment 2009	N	Y	Size, area, gear restrictions; season	N	Y
Market squid	Y	N	N	?	Season, area, lights, vessels	Y	Y
Nearshore fisheries	Y	Y	Y	Y	Control rule, area management, gear re- strictions	Y	Y
Nearshore sharks and rays	N	N	N	N	Rec fishery measures generally; some spe- cies included in NFMP	N	N
Pacific herring	N	Y	Y	Y	Area closures, gear and area restrictions, recent TAC	N	Y
Sea basses ³¹	N	N	N	N	Various: see note.	N	N
Sea Cucumbers	N	N	N	Y	Landings reporting	N	N
Sea urchin	N	N	N	Y	Size limits; no catch allowed Friday, Sat, Sunday (June – Oct) 120.7(l)	N	Y
Spiny lobster	N	Collaborative research	N	Y	Catch reporting, seasons, size	N	Y
Surf perches	N	N	N	N	N	N	N
White seabass	Y	Y	Y	Y	Trigger, season, size, gear	N	?

³¹ Numerous basses are found in California waters including kelp bass, sand bass, spotted bass, white seabass, striped bass, barred bass, spotted sand bass and giant (black) seabass. Taking of giant (black) seabass is prohibited in both sport and recreational fisheries. White seabass are managed under an FMP that provides recreational measures and a bycatch-only take by commercial vessels. Striped bass have a recreational catch limit, and size limit in some areas. Some bass species may come under measures of the NFMP. Recreational fishing regulations include some species-specific time/area closures and size limits.

The MLMA does not call for DFG to develop FMPs for all state species—over 140—on a schedule. It leaves to DFG and the Master Plan decision making on a list of priority species in need of FMPs to achieve conservation goals in the statute. The Master Plan includes a prioritized list of anticipated FMPs, including sea urchins, California halibut, and nearshore sharks and rays. But none of these three species has an FMP, and it appears that other, non-prioritized species are more likely to see FMPs (with the possible exception of California halibut).

DFG has engaged in many activities that would be part of an effort to write one or more additional FMPs. It has :

- supported efforts to gather data that could lead to renewal of a commercial abalone fishery at San Miguel Island. The Department did prepare a noteworthy Abalone Recovery and Management Plan, but it is not an FMP, despite what appears to be a robust research program and progress toward achieving population targets.
- prepared annual regulatory decision-making materials and a framework for Pacific herring; these materials have been characterized by DFG as an “interim FMP.”
- participated in the San Diego Sea Urchin Project, an initiative of the San Diego Watermen’s Association.³²
- worked with advocates for a pilot project to develop a Spiny Lobster FMP using external resources.
- supported the Dungeness Crab Task Force (in response to legislative direction), which reportedly is considering recommendations for an FMP.

DFG personnel also are involved in other data-gathering, monitoring, and research activities that may have connection with MLMA goals and objectives.

One explanation for any reduction in attention to preparing more FMPs is that without clear directives and with limited funding and staffing, other program needs gain priority. Unlike the Master Plan or NFMP, there is no explicit legislative deadline associated with objectives such as protection of marine resource habitat, or adoption of adaptive EBM, and there is no significant consequence for failing to demonstrate progress.³³

DFG has understandably addressed the MLMA’s explicit requirements, but has not made these other goals and objectives a management priority or developed a clear framework and schedule for achieving progress (see earlier discussion). It appears that the basic strategy was, in part, to address these objectives through individual FMPs; the lack of FMPs points out a problem with this strategy. There is no evidence of either an effective internal champion or external advocate for these broader legislative objectives at this time.

The current effort to develop a FMP for the spiny lobster fishery, where the issue is more allocation of catch among competing users than sustainability, illustrates some of these challenges in finding funds. A recent press release issued by DFG stated:

³² There is also a sea urchin initiative supported by the Commercial Fishermen of Santa Barbara to address the shortage of data for that fishery.

³³ *Passage and Implementation of California’s Marine Life Management Act*. July 2009.

*The state's current budget crisis presents both a challenge and an opportunity in moving forward with the preparation of an FMP. DFG does not have the resources to prepare an FMP and carry out the necessary meetings for constituents to contribute to the plan. Because it is uncertain if and when the budget situation will improve, DFG will be trying a new partnership-based approach. DFG is seeking outside funding as well as qualified partners to provide physical help and logistical support. This concept of an exploratory phase has not been used by the department for previous FMPs. If sufficient outside help is not obtained, DFG will not proceed with developing the FMP.*³⁴

New and Emerging Fisheries

According to FGC §§ 7850 and 8140, all fish may be taken at any time for commercial fishing purposes by holders of a commercial fishing license unless otherwise restricted by state or federal laws or regulations adopted pursuant to those laws (e.g., gear types, bag limits, seasons, access).³⁵ This language allows commercial harvest of unregulated species either directly or as incidental catch. The MLMA, however, contains specific language calling for "proactive management" of new and emerging fisheries in §7090(b), and the Commission adopted criteria for identifying an emerging fishery in 2000.³⁶

One example is Kellet's whelk, which can be harvested directly by divers, and is one of several species that can be taken incidentally in traps for rock crab and lobster. The Marine Resources Committee of the Commission has addressed issues related to rock crab and Kellet's whelk during 2009. These discussions were largely species-specific, but highlighted some of the deeply held values among fishers about access to fisheries as well as challenges facing DFG and the FGC in fulfilling their statutory obligations.

Three points merit attention:

1. The MLMA contains language directing the Department to monitor landings and other relevant factors and notify the Commission about each emerging fishery. However, the statute leaves it to the Commission to decide whether to adopt regulations or direct preparation of an FMP, i.e., "may do either, or both, of the following . . ." in §7090(d) (see below). This approach appears inconsistent with the limited resources available to the Commission.

³⁴ DFG News Release, August 17, 2009.

³⁵ FGC §8140: *All fish, the taking of which is not otherwise restricted for commercial purposes, by state or federal law or any regulations adopted pursuant to those laws, may be taken at any time for commercial purposes.* This section of the Code was amended by the MLMA.

³⁶ *It is the policy of the California Fish and Game Commission that: The following criteria shall be utilized by the Department to determine if a fishery qualifies as an "Emerging Fishery" in accordance with Section 7090, Fish and Game Code: (1) The fishery is not a previously established fishery as determined by criteria set forth in Section 7090(b)(2), Fish and Game Code; and (2) The Director shall have determined that the fishery has recently exhibited trends which will result in an increase in landings, an increase in the number of participants, or which may jeopardize a stable fishery. In making this determination, the Director shall consider, but not be limited to, an actual increase in landings of the species in question; an increase in the number of applications for experimental gear permits received by the Commission for this fishery; an increase in the amount or efficiency of the gear used in the fishery; or any evidence that the existing regulations are not sufficient to insure a stable, sustainable fishery.*
(Adopted 10/20/00)

2. New and emerging fisheries are, in general, *data poor* and will not meet DFG's current "single model" requirements for FMPs. If such fisheries are allowed to develop (see next bullet), *ad hoc* management is one possible path based on precedent. An alternative, consistent with recommendations in this report, would be to develop management approaches that focus on improving information about each such fishery over time, beginning with a baseline. Depending on basic policy choices that could be reflected in a revised Master Plan, a step may be to develop explicit precautionary interim management regulations that allow limited harvest and focus on collaborative data gathering to support future FMP development. As noted, the MLMA directs the Department to notify the Commission of an emerging fishery; the Commission is authorized to adopt short-term regulations [up to 12 months], direct preparation of an FMP that includes a three-year evaluation period, or both. The 12-month limitation appears unrealistic under current circumstances, including resource constraints.

3. There is no question that the public currently subsidizes a portion of the total management costs, including enforcement, for commercial fisheries in the state. The state's budget crisis and cost of managing existing fisheries provokes the question whether creating new management costs associated with emerging fisheries is good policy. The MLMA goal of sustainability based on sound information, coupled with the costs of fishery management, raises the question: Who should pay for the costs associated with managing any new or emerging fishery? MLMA §7090(f) authorizes the Commission to impose a fee on an emerging fishery to cover implementation costs, which appears to signal a clear legislative choice.

Adaptive management

Adaptive management is defined in the MLMA as a scientific policy that seeks to improve management by designing management actions as tools for learning, able to provide useful information whether the actions succeed or not.³⁷ This is a good general definition of adaptive management, but neither the statute nor the Master Plan provides any details or guidance about implementation. Adaptive management is mentioned only briefly in the existing FMPs and the way it is mentioned suggests that the authors of the plans did not fully understand the application of this policy.

A definition of adaptive management widely used by the federal government focuses on processes and outcomes to improve policy making without detailing steps:

"A type of natural resource management in which decisions are made as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings and the needs of society. Results are used to modify management policy, strategies, and practices."³⁸

³⁷ MLMA §7056(g), FGC §90.1: "Adaptive management," in regard to a marine fishery, means a scientific policy that seeks to improve management of biological resources, particularly in areas of scientific uncertainty, by viewing program actions as tools for learning. Actions shall be designed so that even if they fail, they will provide useful information for future actions. Monitoring and evaluation shall be emphasized so that the interaction of different elements within the system can be better understood.

³⁸ See, e.g., Unified Federal Policy for a Watershed Approach to Federal Land and Resource Management (Federal Register 65, no. 202, October 18, 2000, p. 62571)

From a policy perspective, the important point is that adaptive management is not a series of after-the-fact reactions to the “latest data” possibly related to the policy goal. Adaptive management requires decision making which recognizes the probability of less than desired results and makes decisions based on the best available science and best available policy tools. Adaptive management equally commits to observing, analyzing and understanding the results of those actions. Finally, adaptive management requires the political, managerial and operational capacity to design and implement improved actions.

Scientists also observe that adaptive management can be a powerful tool for increasing our understanding of fish population and ecosystem dynamics (Walters 1986, Lee 1993). This perspective leads to an emphasis on the use of models and experimental design (Walters 1986), as seen in a recommended seven step process: 1) define the problem; 2) specify the conceptual model or models of how the system functions; 3) evaluate the response of the model systems to various policy options using computer simulation; 4) design the adaptive experiment and evaluate its costs and benefits; 5) implement the experiment if the benefit/cost ratio is favorable; 6) monitor the response of the system to the experiment; 7) revise and update problem definition and models based on the results. At present, DFG probably does not have the capacity to implement adaptive management in this manner. Adaptive experiments tend to be intrusive and require close collaboration with fishers and other constituent groups.

Restricted Access

DFG, the Legislature, and the FGC have used a variety of other policy tools for fishery management both prior to and following MLMA adoption. These tools focus on limiting effort and restricting access to fisheries, which is a key component of sustainable fishery management. When these measures have been adopted with the full engagement of stakeholders, they appear to have produced positive results.

Restricted Access is a resource management approach that limits the fishing power participants put into a fishery, in contrast to other management measures, which limit the amount of fish that participants take out. Achieving the goal of sustainable fisheries requires a combination of both types of measures.

California historically did not restrict the number of participants or amount of fishing effort in its fisheries, so by the 1950s commercial fisheries generally were overcapitalized and had the capacity to exert more fishing pressure than resources could sustain. (FGC Policy) Through department regulation or legislative action in statute, California has attempted to limit the number of commercial vessels or individuals permitted to take specific species or groups of target species. A combination of provisions developed over 10 or more years resulted in a confusing, inconsistent, difficult to administer and sometimes ineffective approach.³⁹

The MLMA recognizes that restricted access is an important tool in the suite of fishery management tools, but does not prescribe such measures for every fishery.⁴⁰ The FGC policy on restricted access developed following MLMA passage provides detailed steps and guidance for how to address each of the questions that will arise when managers

³⁹ *Passage and Implementation of California's Marine Life Management Act*; FGC Policy on Restricted Access.

⁴⁰ FGC §7056

act to restrict access or reduce effort. Its stated purposes are 1) to promote sustainable fisheries; 2) provide for an orderly fishery; 3) promote conservation among fishery participants; and 4) maintain the long-term economic viability of fisheries. (FGC policy)

The inclusion of restricted access in the NFMP is an example of how successful implementation of this tool can achieve objectives of the MLMA. In that case, a collaborative approach that included senior staff, stakeholders, and outside experts created a set of guidelines that helped reduce permits in the fishery from 1200 to approximately 200 over several years. The market squid FMP presents a contrast. Existing participants and the Department had supported proposals to limit effort in the fishery, which was recognized as overcapitalized. These proposals were consistent with the FGC policy, but were overcome by the arguments of potential new entrants who wanted access to the fishery. The failure to include restricted access in the FMP was more indicative of a lack of knowledge, capacity, and resolve on the part of the Commission than on the availability of reliable science or the soundness of the FGC restricted access policy.

Other issues not addressed in the Master Plan or FMPs

A statewide network of MPAs is now being created pursuant to the Marine Life Protection Act (MLPA), and protection of identified areas is beginning. But neither the Master Plan nor any of the FMPs consider how to integrate Marine Protected Areas (MPA) into fishery management, though the North Coast MPA Monitoring Enterprise may make some progress here. The NFMP identifies MPAs as a primary means of conserving essential fish habitat but provides no real guidance on how existence of MPAs affects fisheries management. As MPAs are intended to serve broad ecosystem conservation objectives, their sizes and locations are being established based on those broad objectives. MPAs provide both opportunities and difficulties in the scientific management of fisheries and a careful consideration of how to integrate MPAs into fishery management is needed (Field et al. 2006).

Habitat condition and its importance to sustainable fisheries is not well addressed in the Master Plan or any of the three state FMPs. Habitat damage by activities such as shipping, coastal development, and land-based sources of pollution is commented on but not discussed in terms of its impact on fish stocks. The NFMP depends on habitat protected in MPAs to provide required non-target species benefits, ecological health benefits, non-commercial use benefits and habitat protection. However, MPAs are not being established with specific fishery needs in mind and resource managers cannot depend on MPAs to provide all these benefits. Very near shore habitats in particular do not receive attention commensurate with their potential value and importance.

Changes in physical habitat that may result from climate change, such as changes in sea surface temperature, changes in seasonal upwelling, reduced freshwater inflow to coastal waters, and ocean acidification are not discussed in detail in the FMPs or other fishery management actions. These changes have the potential to impact heavily on CA fisheries and deserve consideration.

Lessons learned

1. The intended role of FMPs under the MLMA as a central management tool has not been realized in the MLMA's first decade, and that situation is unlikely to change significantly in the foreseeable future due to several factors, including lack of resources and inadequate EFI.
2. The Master Plan has clear strengths but its potential has not been realized. A perceived lack of flexibility in the Master Plan involving EFI and requirements for FMP development has become a significant obstacle and generated at least one effort at legislative clarification, i.e., MLMA "lite."
3. It is reasonable to expect little or no change to established fishery management regimes, e.g., the *status quo*, absent significant evidence of problems. The *status quo* applies to many state-managed fisheries, but the lack of EFI for many fisheries undermines the foundation for business as usual. Even with significant evidence it has been difficult to reduce harvests, e.g., the herring fishery.
4. There is some evidence that the FMP development process, including stakeholder engagement, leads to robust use of management tools, including annual catch limits, consistent with the need for precaution in light of data gaps. A more flexible approach to the requirements for FMPs has the potential to increase the overall level of precaution in management of state fisheries.
5. A strategy of addressing the potential role of MPAs in fisheries management through individual FMPs, rather than as a discrete policy, is unlikely to show measureable progress in the foreseeable future.

Working with Stakeholders

The MLMA states that “successful fishery management is a collaborative process that requires a high degree of ongoing communication and participation of all those involved in the management process, particularly the commission, the department, and those who represent the people and resources that will be most affected by fishery management decisions, especially fishery participants and other interested parties.”⁴¹ The anticipated benefits of this collaboration apply to “most fishery management activities including . . . the development and implementation of research plans, fishery management plans, and plan amendments, and the preparation of fishery status reports . . .” DFG and the FGC are accordingly directed, i.e., “shall,” to “[d]evelop a process for the involvement of interested parties and for fact finding and dispute resolution processes appropriate to each element in the fishery management plan process”⁴²

This emphasis on collaboration and constituent involvement over traditional command-and-control decision making was, and remains, a key aspect of the MLMA.⁴³ Fundamentally, the MLMA directed DFG to expand its comfort zone by giving up some control over decision making processes while retaining its legal authority. The shift is not simply about more public meetings, which were a familiar tool for both DFG and the FGC. Public meetings can be useful ways of conveying information, improving understanding, and gathering input, but they are not typically a forum that promotes collaborative decision making and management. This shift also is about more than talking with fishery participants or researching fisheries; DFG has always worked directly with fishers both on land and on the water. Another familiar and traditional tool is the use of advisory committees for gathering views from fishery participants, outside scientists, and others.

As noted in the *Passage and Implementation of California’s Marine Life Management Act*—and to its credit—DFG committed significant resources to developing meaningful public engagement frameworks, specific tools appropriate to different types of decisions or activities, and internal capacity to meet this obligation.⁴⁴ Outside experts were part of this effort along with DFG staff. One concrete result can be found in the Master Plan’s detailed framework for public involvement in FMP development in Chapter 5. It specifies four possible levels of involvement, and a set of criteria to determine which level is appropriate. Table 5 illustrates these four levels and the type of activity associated with each.

⁴¹ FGC §7059(a)(1)

⁴² *Id.* (b)(2)

⁴³ See Weber and Heneman, p.7: Constituent involvement is one of four general policies for achieving MLMA goals.

⁴⁴ *Passage and Implementation of California’s Marine Life Management Act* at 45

Table 5. Master Plan categories of public involvement

Table 5-1. Levels of public involvement and associated methods and activities.	
Public Involvement	Methods and Activities
Standard	Notice of announcement, public notice, fact sheet, public review, questionnaire and comment forms, web site
Level I	Peer review, meetings, workshops
Level II	Advisory committees, consensus building panels
Level III	Formal dispute resolution

The NFMP was, in some respects, a field test for DFG's new approach to constituent engagement. That process is described in detail in the *Passage and Implementation of California's Marine Life Management Act*. Based on interviews and research, the NFMP process produced very mixed reviews and has had a significant influence on DFG's unwillingness to develop future FMPs. The \$10 million estimated cost includes a large amount of staff time and external consultant resources devoted to involving the public. Some within DFG perceived very limited benefits from the many hours spent working with the NFMP advisory committee. The failure to reach negotiated agreements on key issues such as allocation between recreational and commercial fisheries raised fair questions about what was achieved and whether it could have been done with fewer resources or using a different mix of approaches.

It is apparent from interviews and DFG's own internal review that concerns about the cost of public engagement based on the NFMP experience (and others) have become an obstacle to advancing the MLMA goal. The recent call for outside partners to support the costs of facilitation for a Spiny Lobster FMP process (cited above) is an indicator of these concerns.

DFG has not simply abandoned public engagement, however. It is involved with fishery participants and others in a limited number of projects intended to explore alternative approaches to data-gathering and research and co-management. It appears that most, if not all, of these projects originated with stakeholders and not within the Department. DFG staff continue to hold public meetings, and to talk directly with individuals and organizations pursuing innovation. DFG personnel are participating in the legislatively mandated Dungeness crab task force. And DFG's ongoing involvement in the MLPA planning process, with its intensive model of stakeholder involvement, is contributing to internal capacity building in the Marine Region even as it places more demands on reduced resources. Figure 6 shows a partial list of committees and other forums where DFG staff participate; most of these focus on specific fisheries or locations and involve stakeholders as well as agency officials.

There are two core challenges for DFG around public engagement. The first is in comfortably giving over some decision making process control while retaining its authority. The traditional top-down, command-and-control view was present within DFG [and on the FGC] when the MLMA was enacted, and interviews suggest that it has remained influential over the past decade. Giving up some process control in favor of more meaningful engagement in decision

making has been difficult, particularly because it places DFG personnel in a position of being directly accountable and needing to justify policy choices, and be open to the MLMA's encouragement of "creativity." The traditional model places fewer demands and, given resource constraints, can be seen as an attractive refuge. DFG is inevitably seeing change in personnel over time, however, and this change also is slowly influencing willingness to collaborate, particularly as new staff gain experience in more open processes. The variation in DFG's approach to public engagement reflects both the lingering influence of command-and-control and the views of a new generation of DFG staff whose expectation is that collaboration is the most common approach.

The second challenge is in supporting substantive change in marine resource management. The purpose of public engagement is to respond to the MLMA's view, stated above, that successful fishery management is a collaborative process beginning with baseline data collection and continuing through policy making, implementation and adaptive management. The statute intends that DFG meaningfully explore collaborative data-gathering and research, and meaningfully address various forms of co-management. California must continue to develop incentives for fishery participants to conserve resources, and this cannot be done without testing models for shared management. DFG's commitment to collaboration is being tested and, at least in the eyes of some, found wanting to this point. There is an external perception of fundamental resistance to change in the way DFG manages the state's marine resources: not simply caution, but active opposition, to an approach where DFG retains its responsibility to protect public trust resources but is willing to take some reasonable risks, and even accept some failures, in order to learn what can work in partnership with fishery participants and others. In some instances, it is likely that DFG resists investing its limited funds and staff where it judges the issue is largely economic conflict among users and the living marine resource is not threatened by current use patterns.

Finally, there is reason to believe based on interviews for this project that key fishery participants, advocates, and others appreciate the costs of public engagement and would be willing to accept tradeoffs between quantity and quality. In other words, if the engagement is meaningful and has a clear impact, the amount of time and the costs potentially can be reduced. However, it is also the case that the current implementation phase of the MLPA has been characterized by extensive support for high levels of stakeholder involvement and public processes and some stakeholders may form expectations based on those efforts.⁴⁵

Lesson Learned

1. It would be unrealistic to expect a profound shift away from traditional command and control fisheries management in a single decade, even in California.
2. The MLMA and Master Plan promote a collegial and collaborative approach to FMP development and implementation through constituent involvement. However, DFG often appears to interpret constituent involvement rather narrowly as a consultative process with DFG firmly in control. The failure to generate

⁴⁵ The private sector has been a significant source of funding for the MLPA Initiative planning process, including its intensive public engagement.

significant collaboration in marine resource management overshadows DFG's participation in a handful of pilot projects and underscores a lack of initiative.

3. The NFMP describes a number of successful and beneficial projects in which managers, academics and fishers worked together and suggests that more such projects would be a good idea but does not identify any particular candidate projects. Benefits of fisher's knowledge and fleet infrastructure as well as the engagement of fishers as part of the management process cannot be realized by effectively keeping fishers at arm's length.⁴⁶ Ultimately, collaborative research and management provide a way to reduce costs and enhance effectiveness of management. (See, for example, the experiences of Starr, Wendt, Wilson, Culver, Schlosser and Halmay, among others).
4. DFG staff members face significant demands to engage with the public in many forums. Taken as a whole, the value of this participation is not evident on its face, particularly given staffing shortages and inability to implement MLMA direction on EBM and adaptive management, or to analyze existing fishery information. There is reason to believe that, in some cases, less but better direct engagement with the public may lead to more concrete MLMA results.

⁴⁶ In other words, it is not enough simply to sit in the same room with fishery participants, no matter how many meetings that includes. The focus must be on collaborative decision making.

Figure 6. DFG roles with stakeholders

Group Name	DFG Role
Abalone Advisory group – San Miguel Island	Support – constituents
Abalone San Miguel Island Technical Panel	Member
Benthic Habitat Goal Project	Advisory
Bolinas lagoon Project Reformation Advisory Group	Advisory
Bolinas Lagoon TAC	Member
California Coastal National Monument Co-manager	Co-Manager of CCNM with BLM & State Parks
California Sea Urchin Commission	Non-voting member
Channel Islands Sanctuary Advisory Council	Member
Collaborative Marine Research Program--CINMS	Evaluate and select proposals for funding
Director's Herring Advisory Committee	Support – constituents
GFNMS Bolinas Lagoon Ecosystem	Advisory
Humboldt Bay Benthic Habitat Goals project	Advisory Team member
Humboldt Bay Ecosystem based management program	Advisory Team member
Humboldt Bay Ecosystem Based Management Program (EBM) Core Team	Advisory
Interagency Oil & Gas Decommissioning Working Group	Member
Long Term Management Strategy (for dredged materials in SF Bay) - Management Committee	Consultation/Recommendations
Monterey Bay Sanctuary Advisory Council	Voting Member
Northcoast Critical Coastal Areas committee	Advisory
Ocean Resources Hatchery Enhancement Program Advisory Panel	Support –constituents
Recreational Abalone Advisory Committee	Support –constituents
Santa Monica Bay Restoration Commission Technical Advisory Committee (TAC)	Voting Member
Southern California Caulerpa Action Team	Vice-Chair
Subtidal Habitat Goals Management Committee	Member
Tomales Bay Mooring Committee	Voting Member
Tomales Bay Shellfish TAC	Voting Member

Source: DFG. This is not a complete list but gives a flavor for the kinds of committees staff participates in or supports. These are all constituent groups in one form or another; some are multi-agency; some agency and public members; some are fishing constituents only.

Information on sustainable use of living marine resources

The goal of the MLMA is sustainable use of living marine resources. The law places considerable emphasis on the importance of good science for effective fishery management⁴⁷. As summarized by Weber and Heneman (2000):

"Fishery management decisions are to be based on the best available scientific and other relevant information, including what the MLMA calls essential fishery information. Essential fishery information includes the biology of fish, population status and trends, fishing effort, catch levels, and impacts of fishing" [93].

There is substantial evidence that many California fisheries are reduced. Since 1995, there have been significant decreases in commercial landings, revenues, and vessels, with a general understanding that these declines are attributable primarily to a failure of fish populations to recover from a combination of coastal development and pollution, overfishing, and other problems. The coast of California falls within the larger California Current Large Marine Ecosystem. As Halpern et al. (2009) have shown, this ecosystem is heavily affected by a broad array of human activities and is highly sensitive to impending climate change.

The iconic salmon fishery collapsed several years ago, and at least two environmentally-sensitive and commercially-important species, Pacific herring and market squid, are susceptible to environmental changes such as ocean temperature. The herring fishery is of concern because it is managed under a relatively "modern" framework and was recently closed because of population declines. The squid fishery is of concern because effort continues to expand in the fishery yet there is currently no program to estimate biomass or stock status.

On the other hand, there is some evidence that these recent declines may be reversible. In a recent survey of the status of global fisheries in 10 large marine ecosystems around the world, Worm, et. al.⁴⁸ concluded:

"However, biomass has recently been increasing above the long-term average in Iceland, the Northeast U.S. Shelf, and the California Current, while remaining relatively stable or decreasing elsewhere."

They attribute the increasing biomass in the California current (which extends from southern British Columbia to Baja California) to use of four of eight possible management tools (gear restrictions, fishing capacity reduced, total allowable catch reduced, and closed areas). Worm *et al.*'s analysis was based, however, on only a small number of the many species managed by California.

Whatever the broad patterns may be, it is clear that California lacks the robust data needed to guide management as the MLMA envisioned in 1998 and requires today. The law does give detailed guidance about EFI— its acquisition, quality, application and dissemination. EFI listed in the MLMA includes "information about fish life history and habitat requirements; the status and trends of fish populations, fishing effort, and catch levels; fishery effects on fish age structure and on other marine living resources and users, and any other information related to the biology of a fish

⁴⁷ This paragraph and several others in this section are drawn from a paper prepared by Michael Healey and Ralph Larson, two members of the MLMA-LL research team, for this report. The full paper is in Appendix 1.

⁴⁸ Worm *et al.* "Rebuilding Global Fisheries." *Science*, Volume 325. July 31, 2009. 578-585.

species or to taking in the fishery that is necessary to permit fisheries to be managed.”⁴⁹

The first plank in the information platform was to be an annual report on the status of California’s sport and commercial fisheries. Each report was to cover one-fourth of the fisheries so that information on every fishery was up-dated every four years.⁵⁰

The MLMA also requires a Master Plan and Fishery Management Plans. Both rely heavily on EFI. For example, the Master Plan elaborates the statutory definition of EFI to include both biological and socioeconomic variables:

Biological EFI

Age and growth
Stock distribution
Ecological interactions
Indices of abundance
Movement patterns
Recruitment
Reproduction
Total mortality

Socioeconomic EFI

Employment
Expenditures
Resource demand
Revenue
User/industry demographics

The Master Plan scored all California fisheries as either “data rich,” data moderate,” or “data poor” based on existing information. Using this scoring system, only the two species of kelp [listed in the Master Plan] had a majority of biological variables in the data rich category. Among the remaining fisheries, only California halibut was reasonably well known biologically, with 4 variables in the data rich category and 4 in the data moderate category. Socioeconomic variables were data poor for all fisheries. This and other analyses indicate that the data for most California fisheries is inadequate for preparation of “single model” FMPs that are required to address all specifications in the MLMA.⁵¹ Table 6 (Table 4-2 from the Master Plan) illustrates the lack of EFI for the ten species identified as candidates for preparation of the FMPs required by the MLMA.

FMPs that have been completed in the first MLMA decade include research programs to gather EFI but contain no timetable for gathering these data and moving species from data poor to data moderate or data rich. Overall, progress in building a base of EFI for most species has been slow.

In 2008, Botsford and Kilduff analyzed 149 fisheries in California organized into eight groups, with the results shown in Table 2. Landing data are available for over 90 percent of these fisheries, and size composition of catch is available for 60 percent. The life histories of 86 percent of the fished species are understood. In contrast, the age

⁴⁹ Fish and Game Code, Ch. 2, Sec. 93; MLMA Ch. 2. Marine Life Definitions.

⁵⁰ §7065

⁵¹ *Science and the MLMA*, Appendix 1, p. 3.

composition of only 22 percent of fisheries is known and stock assessments are available for only 31 percent of the fisheries.

This analysis suggests information needed to manage for long-term sustainability is being developed. More broadly, it is important to note that the MLMA anticipated managing species with varying levels of information. The tools employed need to match the available information. Equally importantly, fishery management policies can increase essential information over time, allowing use of different management tools which require better information. As an example of how new policies can improve information available, all of the nearshore stock assessments now available [for seven species, but only five have been used in management] have taken place after passage of the MLMA.

As noted above, the MLMA and the Master Plan both require socioeconomic data as well as EFI. But socioeconomic data are virtually non-existent for most fisheries and the FMPs completed so far provide only limited insight into the social and economic aspects of fishing. The NFMP [covering 19 species] identifies a list of socioeconomic EFI and suggests some ways these data could be used, but does not provide a model or framework for prioritizing socioeconomic data or for incorporating the results of socioeconomic analyses into fishery management. If regional management anticipated in the NFMP is to become a reality, better understanding of socioeconomics will be necessary in order to achieve the "fairness" principles in the MLMA.

Table 6. Fishery information reported in Master Plan, 2001

Table 4-2. Status of essential fishery information (EFI) for the 10 highest priority fishery management plans (FMPs) identified in the Master Plan. R = data-rich, M = data-moderate, and P = data-poor (see text for definitions of these categories).										
FMP	Species	Age and growth	Stock distribution	Ecological interactions	Indices of abundance	Movement patterns	Recruitment	Reproduction	Socioeconomics	Total mortality
Sea Urchins	Red sea urchin	R	P	M	M	R	M	R	P	M
	Purple sea urchin	R	P	M	M	R	M	R	P	M
California Halibut	California halibut	R	R	R	M	R	M	R	P	M
Nearshore Sharks and Rays	Brown smoothhound	M	P	P	P	P	P	M	P	P
	Gray smoothhound	M	P	P	P	P	P	M	P	P
	Pacific angel shark	M	P	P	P	M	P	M	P	P
	Shovelnose guitarfish	M	P	P	P	P	P	P	P	P
	Bat ray	M	P	P	P	P	P	M	P	P
Surfperches	White seaperch	P	P	M	P	P	P	M	P	P
	Redtail surfperch	P	P	P	M	P	P	M	P	M
	Pile perch	P	P	M	P	P	P	M	P	P
	Shiner perch	M	P	M	M	M	P	M	P	P
	Walleye perch	P	P	M	P	M	P	M	P	P
	Black perch	P	P	M	P	M	P	M	P	P
	Barred surfperch	M	P	P	M	M	P	M	P	M
	Rainbow surfperch	P	P	P	P	P	P	M	P	P
	Striped seaperch	M	P	M	P	M	P	M	P	P
	Rubberlip seaperch	P	P	P	P	P	P	P	P	P
Sea Basses	Barred sand bass	R	R	M	M	M	P	R	P	M
	Kelp bass	R	R	M	M	M	P	R	P	M
Spiny Lobster	California spiny lobster	R	P	M	M	M	P	R	P	M
Sea Cucumbers	Giant red sea cucumber	M	P	P	P	P	P	M	P	P
	Warty sea cucumber	P	P	M	P	P	P	P	P	P
Subtidal Snails	Kellett's whelk	P	P	P	P	P	P	P	P	P
	Wavy top shell	P	P	P	P	P	P	P	P	P
Intertidal Invertebrates	Top shells (<i>Tegula</i> spp.)	P	P	M	P	P	P	P	P	M
	Giant owl limpet	M	P	M	M	M	P	P	P	P
Kelp	Giant Kelp	R	R	M	R	R	R	R	P	R
	Bull Kelp	R	R	R	M	M	R	R	P	M

Table 7. Information available on California fisheries, 2008

Category (from Leet, et al. 2003)	Total number of species	Landings	Number of species in category with these data					No data
			Effort	Size composition	Age composition	Stock assessed	Life history	
Nearshore invertebrates	19	18	8	5	0	0	16	1
Nearshore finfish	68	65	46	47	10	13	54	3
Coastal pelagic species	5	5	3	1	3	2	5	0
Highly migratory species	15	15	7	9	3	7	13	0
Groundfish	19	19	16	19	12	19	18	0
Salmon	4	4	3	4	3	3	4	0
Estuarine invertebrates	6	1	2	0	0	0	6	5
Estuarine finfish	13	8	4	5	1	2	12	5
TOTAL	149	135	89	90	32	46	128	14
% of total		90.6	59.7	60.4	21.5	30.9	85.9	9.4

Source: Adapted from Louis W. Botsford and D. Patrick Kilduff. *The data-richness spectrum and sustainability of California fisheries*.
Workshop: Managing *Data poor* Fisheries. December 2008

In addition to requiring EFI and socioeconomic data, the MLMA also set a new direction for fishery management by seeking to ensure both sustainable fisheries and healthy marine ecosystems. The MLMA prescribes EBM to achieve this broader goal. The intent to move toward EBM is affirmed in the three FMPs discussed above, but none of the documents state what EBM means and how it will affect management. The NFMP lists a number of possible indicators of fishery effects on the ecosystem but does not provide any conceptual model or framework that would connect these variables with fish production or management. Without these kinds of organizing frameworks it is difficult to assess how management will proceed, whether it will be sustainable, and how the management system will respond to future changes.

Finally, information on recreational take is improving, a critical need. The recreational take is low in some fisheries, such as market squid or northern anchovy. But recreational fishers are responsible for all abalone taken, and are active in the near shore fishery, where one analyst concluded recreational fishers were responsible for landing more tons of vermillion rockfish in Southern California than commercial fishers from 1970 through 2003.⁵² The WSB FMP directly addresses large recreational catches. The state, through both DFG and OPC, has initiated efforts to improve data on recreational fisheries, including improvements to the California Recreational Fisheries Survey, Commercial Passenger Fishing Vessel (CPFV) data, and the “report card” programs for abalone and spiny lobster.

Lessons Learned

1. The MLMA sought to place fishery management, and the management of other living marine resources, on a solid foundation of scientific information about EFI, socioeconomic information, and understanding of the health of living marine resources other than fisheries. But progress towards this goal has been slow. Most fisheries are still *data poor*, and the Department has yet to make significant progress towards defining – much less towards gathering and using systematically – information about socioeconomics and living marine resources other than fish.
2. When EFI is lacking, scientists agree that the best course is precautionary management – i.e., setting lower harvest levels and using various regulatory tools to limit impacts on fisheries and other living marine resources. Sometimes this creates incentives for fishermen to work with scientists to gather better information; in other cases, it encourages fishery participants to resist the Department’s management approach in multiple forums including the FGC and Legislature. While the Master Plan sets out priorities for EFI, it is not clear that DFG’s decisions about what information to gather are based primarily on that plan.

⁵² Alex MacCall. *Recreational Fishery Monitoring and Stock Assessment*. PowerPoint presentation to the Pacific States Marine Fisheries Council Recfin Workshop, August 2006, Portland, OR.

Recommendations

As noted at the beginning of this report, policy makers and managers have greatest control over (1) institutions and policies, and (2) implementation. Additionally, good information is needed to evaluate progress toward achieving the MLMA policy goal of sustainable use of living marine resources. Effective collaboration and interactions with others improves understanding of relevant physical, biological and human systems and of relevant institutional, policy and management tools to inform management actions. The recommendations which follow address all these issues.

The first three recommendations are high priority actions intended to more effectively focus DFG and Commission resources for the management of living marine resources. The MLMA provides both the goals of sustainable use and EBM and relevant policy and management tools. These goals are also included in other federal and state legislation and additional policy and management tools are provided to the Department and the Commission under legal authority separate from the MLMA. These three recommended actions recognize that the MLMA provides important tools but that the real test of success is judged by achieving the two goals of sustainability and EBM.

Recommendation 1: Develop an effective management plan for living marine resources, considering the MLMA as one tool among those available.

The FGC should direct DFG to draft a practical, achievable management plan for the next three years that includes goals, objectives, resources, and timeframes to manage living marine resources. The draft plan should include:

1. Realistic targets for budget and staffing of both the Marine Region and the Commission for the three-year period. Given the current fiscal situation of California, a likely prudent assumption is no budget augmentation during this three-year period, so emphasis should be given to objectives and management actions that are consistent with current resource levels.
2. Selection of priority actions among pending regulatory items requiring Commission action and establishment of milestones for progress. The limited commercial abalone fishery off San Miguel Island is one example of such a pending action. Consideration of the priority of non-regulatory actions, such as completion of the update to the MLMA Master Plan, should be deferred until a schedule for addressing pending regulatory action is complete.⁵³
3. A priority on developing management approaches that encompass more than a single species. The current and foreseeable constraints on available funds for data gathering and FMP development argue for better approaches to utilizing the basic FMP tool required by the MLMA. The statute does

⁵³ Regulatory actions, including FMPs, can be simply stated. The single sentence "All fisheries without a quantitative stock assessment shall be managed in accordance with the precautionary approach of setting TAC at 50 percent proxy MSY based on recent catch data" is a fishery policy that could become a regulation. It reflects the precautionary approach of Restrepo *et al.* and would provide an incentive for fishers to support improved data collection and analysis.

not mandate that FMPs focus only on a single species, and there is one example of an existing multi-species FMP for near-shore species. This focus will also afford the opportunity to articulate with MPAs: are there opportunities for FMPs that would align with MLPA study regions and habitats, establishment of MPAs by the FGC, and monitoring and research including the Monitoring Enterprise?

As appropriate, this management plan can also include:

- Specific steps to increase use of the tools provided by the MLMA – the Status Report, Master Plan, FMPs, ecosystem-based management, and adaptive management (and perhaps others) – in a more flexible manner.
- Specific protocols that articulate how MLMA tools (e.g., FMPs) can be used in conjunction with tools provided by other laws, especially MPAs created pursuant to the MLPA.
- Specific initiatives or pilot projects that DFG will pursue to collaboratively engage recreational and commercial fishermen, environmental groups, researchers, and other stakeholders to gather necessary data and participate in designing and managing marine resources on a sustainable basis. Each initiative or pilot should be linked to specific objectives or milestones that will have application in other fisheries.

The proposed management plan should be discussed at a public hearing of the Commission with opportunity for public comment. The FGC should then adopt the plan as policy guidance for DFG and review progress regarding achievements under the plan on at least an annual basis. The management plan should be updated in its third year and thereafter on the four year schedule for revision of the Master Plan anticipated in the MLMA. The plan may incorporate improvements in developing information, effectively incorporating science and appropriate roles for stakeholder involvement, discussed below, as they are available. However, completion of the management plan should not be delayed awaiting completion of these efforts as it can be adjusted as necessary later. The management plan should evolve over time as required to most effectively achieve the goals of sustainability and EBM. The management plan should be informed by the provisions of the MLMA, including those regarding a Master Plan. If experience demonstrates that those provisions are not appropriate they should be modified, including through any needed “clean up” legislation.

The management plan should (a) clarify expectations among policy makers, managers and stakeholders about work to be accomplished in the near future, (b) focus energy, and (c) provide a framework for assessing progress toward sustainability and EBM. These steps are critical to more effective management of living marine resources.

Importantly, this recommendation does not focus on the MLMA alone, but rather on management of living marine resources, including use of tools available in the MLMA. Shifting the focus to the goals of sustainability and EBM and conscious consideration of which tools will promote progress

toward those goals within available resources is preferable to focusing serially on individual policies, including the MLMA. It is also far preferable to expenditure of resources without conscious direction and stated expectations of what can be achieved and what, realistically, cannot. In any three-year period, public resources will be spent managing living marine resources: the DFG will be staffed, the FGC will meet, OPC will operate, and so too will some legislative attention be given to these issues. In simplest form, this recommendation is to give conscious, public attention to the use of those resources for the common goals of sustainable use and EBM.

Time periods:

- FGC charge to DFG, by March 31, 2010
- DFG completes plan draft, by September 1, 2010
- FGC public hearing and action on management plan by December 1, 2010⁵⁴

Recommendation 2: Elevate the importance of information in managing living marine resources, effectively moving toward “Fishery Information and Management Plans.”

Fishery policy making and management over the next decade should give high priority to improving information about living marine resources. No single factor explains why only a few FMPs are completed to this point under the MLMA. However, the general lack of EFI is consistently identified as a significant factor. More recommendations regarding science and EFI follow below, but formal recognition of both the importance of information in fisheries management, including FMPs, and the reality that *FMPs can be developed for data-poor fisheries* is fundamental. A shorthand way of capturing this is a change in understanding, if not legal terminology: the goal is to develop effective Fishery *Information* and Management Plans (FIMPs) in which management actions improve information and are informed by it, rather than “FMPs” based on information available at a single point in time.

Implementing this recommendation requires (1) establishing measures of sustainable use of living marine resources (including measures now available) and planning to improve the breadth, accuracy and usability of additional measures over time, and (2) working effectively with others who contribute information about the status of living marine resources, including universities, fishers, other agencies and other sources. Information gathering is costly, and should be explicitly directed to improving the ability of managers and policy makers to evaluate progress toward sustainability.

An immediate step should be to convene one or more workshops to address a straw proposal developed by DFG that builds on ideas and progress from the data-poor fisheries workshop in December

⁵⁴ These timeframes assume basic continuity in MLMA implementation following next November’s elections [2010].

2008. That workshop identified a number of approaches that appear to merit follow up.⁵⁵ The objective should be a specific policy proposal for adoption by the FGC that describes how FMPs will focus on improving EFI. This proposal should be consistent with any future modifications to the Master Plan.

Time periods:

- DFG organizes successor to data-poor fisheries workshop by September 30, 2010
- DFG completes a proposal for consideration by the FGC, by March 31, 2011
- FGC public hearing and approval of management plan, by December 1, 2011

Recommendation 3: Establish management processes ensuring that the privilege of harvesting public trust resources carries an obligation to pay for the costs of collecting data and the management actions required to support sustainable management.

Fishery participants benefit directly from harvesting public trust marine resources. In light of the legislature's stated intent to move fisheries management to more scientific, data-based decision making, there is a clear need for reliable data and continued management. A majority of the state's fisheries are data-poor, and the state cannot afford the costs of collecting and analyzing data for all those fisheries. Equally, fisheries are expected to pay costs for their management, which includes development of the management tools, their implementation and adaptive management. The Commission, in conjunction with DFG, should develop and implement a policy that requires fishery participants, both commercial and recreational, to bear the costs of data collection necessary for effective management, including development of FMPs and subsequent adaptive management. The same general expectations apply to emerging fisheries and the management processes developed should conform to the requirements of section 7090 of the MLMA.

Implementing this policy may require difficult decisions regarding management of fisheries of modest economic returns that are limited their capacity to fund data collection and other management costs. Among the options to address this issue may be (a) multi-species plans, (b) spatially-bounded plans, or (c) limiting the fishery to a level consistent with the data which can be obtained and management tools which can be used,⁵⁶ or some combination of these and other approaches.⁵⁷

Time periods:

⁵⁵ See, e.g., papers by Ditchman and Prince. These initial recommendations are based on a review of workshop presentations for this project.

⁵⁶ . One option that could serve dual purposes of precaution and creating incentives for data collection would be to set Total Allowable Catch based on 50 percent of proxy Maximum Sustained Yield, consistent with the well known "Restrepo" approach to precautionary management.

⁵⁷ While beyond the scope of this report, the Legislature may wish to develop a broader "fee for use" approach applicable to all marine resource activities including those where no harvest is involved to address management needs, including enforcement and monitoring..The MLMA recognizes the importance of these values. See, e.g., *Guide to the MLMA* at 3.

- Develop draft policy by July 1, 2010
- FGC public hearing and action by February 1, 2011

Longer term recommendations⁵⁸

The MLMA set higher expectations for fishery management in California. However, improved institutional capacity and performance will benefit ALL management of living marine resources. This section advances such recommendations without specifying time periods. But all should be at least initiated during 2010, and substantial progress can be made on some within the year. The recommendations are organized according to the six elements of Figure 1, discussed at the beginning of the report (p. 11).

Sound institutional and policy foundation

Recommendation 4: The Legislature should transfer full authority for interpretation of marine fishery management legislation and management of state fisheries to the FGC [and DFG] or other policy making body see Recommendation 5 below. The Legislature should not hear appeals from individual fishery groups, either recreational or commercial, for legislation to “fix” their specific problems.

California’s current institutional arrangements among the Legislature, FGC, and DFG for managing living marine resources perpetuate fragmentation of authority, create inconsistent policies, and divert limited resources from core tasks to serve individual fisheries. Fragmentation of authority in fishery management, particularly legislative intervention on individual fisheries, undermines effective marshalling of the state’s limited resources for MLMA implementation. The Legislature should support science-based decision making over single-fishery preference and reduce fragmentation. There should be no direct or indirect legislative appeal of individual fishery management decisions, e.g., a DFG decision about priority species for FMPs, or the content of a FMP. The Legislature should focus on oversight that is linked to the management plan described in Recommendation 1 above, in addition to budget.

The Legislature transferred some authority for species and ecosystem management to FGC and DFG under the MLMA, and this likely contributed to reducing fragmentation of authority.⁵⁹ However, the Legislature retained the ability to set policy for individual species and has exercised that authority

⁵⁸Some of these recommendations are excerpted from *Science and the MLMA*, prepared for this project and attached as Appendix 1.

⁵⁹ FGC §7051(b). The failed MLMA “Lite” effort amended this provision and arguably would have broadened the authority of the FGC and DFG.

multiple times since passage of the statute.⁶⁰ This lingering fragmentation of authority creates multiple opportunities for single-interest groups or fisheries to “shop” their ideas: they can pursue single-species objectives with DFG, the FGC, the OPC, and the Legislature, sometimes concurrently. According to representatives of both the Department and Commission this system contributes to unproductive and even harmful friction between the FGC and DFG and a lack of unified leadership on marine resource management.

The option to seek legislative action if state agencies are unresponsive raises significant questions, particularly given the current lack of marine resource experience in the Legislature and the consequences of a legislative enactment. One recent example already mentioned is legislation directing that the OPC establish the Dungeness Crab Task Force (DCTF). According to interviews the DCTF legislation was an outcome of a political strategy by a small group interested in this single fishery.⁶¹ The DCTF legislative mandate effectively moves that fishery forward in the priority system for FMPs, regardless of the Master Plan.⁶²

There is no question that oversight and budget authority are bedrock roles for the Legislature, and that constituent, i.e., voter, communication is a fundamental task for the state’s legislators. Legislating species- or fishery-specific legislation, however, diverts increasingly limited resources within DFG. Interviews within and outside DFG indicate that the Department lacks personnel resources to address legislative demands without pulling staff, sometimes from a very small group of highly trained scientists, from critical technical tasks related directly to the MLMA (and MLPA). Moreover, while constituent service is a core responsibility of elected officials, narrow legislation aimed at a single species or single community are not consistent with the MLMA’s goal of ecosystem-based marine resource management. This narrow, single-species focus is more reflective of political influence than of the science-based policy-making that is an MLMA priority.

One other perspective offered during interviews for this report is that institutional fragmentation is exacerbated by current dynamics involving recreational and commercial fishery participants. This is a complex and sensitive topic, with multiple threads, and beyond the scope of this report to fully describe let alone evaluate. The following merit consideration as possible factors influencing fragmentation that undermines effective marine resource management:

- The MLMA itself represents a basic competition between recreational and commercial fishers for harvest share. The statute reportedly received critical last-minute support for passage and signature from recreational fishing advocates who saw, in part, an opportunity

⁶⁰ AB 571, discussed earlier in this report, is a recent example.

⁶¹ This report does not take a position about the importance of issues being addressed by the DCTF for that fishery and its participants.

⁶² Dungeness Crab are not one of the three species prioritized for a FMP in the 2001 Master Plan. In fact Dungeness Crab are not on the list of invertebrate species developed for consideration of FMP priority. See pp. 3-6 (Table 3-3), 3-8.

to limit the commercial near shore fishery, which had historically been fished primarily by recreational fishers.

- The halibut trawl bill is a frequently cited example of recreational fishers seeking to reduce commercial take for their own benefit.
- There appears to be a relatively low level of agreement on the impacts of recreational fishing in California, due in part to arguments about data. Commercial fishery impacts are relatively better understood, and some observers appear convinced that recreational fishing advocates are fundamentally opposed to improving data for their fisheries or to a scientific discussion of impacts on fish populations. As discussed above, information on recreational fishing is being improved and this effort should be given continued priority by DFG and the Commission.
- There appears to be a significant and growing difference in the relative influence of commercial and recreational fishery participants, with commercial influence declining and recreation influence perceived as steadily increasing and supported by significant resources.
- In addition to new MPAs, one legacy of the MLPA planning process may be improvements in understanding of interests and communication among some individual commercial and recreational fishery participants and conservation advocates that have the potential to reduce conflicts over allocation.

Recommendation 5: Improve the capacity of the Commission and focus its work on broader policy and management roles and away from individual resource user actions.

There is good reason to believe that enhancing the FGC capacity in multiple categories will improve management of living marine resources and MLMA implementation. A more capable and focused Commission could support developing EFI, adopting a revised Master Plan, adopting additional FMPs and, perhaps most importantly, more attention to working with the Department in establishing and maintaining effective programs in the face of limited resources and consistent pressure from narrow interests to advance their agendas. The project team considered multiple options for achieving this objective:

- Create a separate marine resources commission, as envisioned in the original MLMA legislation, that includes marine science and fishery participation expertise
- Create a standing external advisory committee to the FGC on marine resource stewardship, including both MLPA and MLMA, filled by people with demonstrated expertise by training or experience

- Take the MLPA model of a Blue Ribbon Task Force/Science Advisory Team and expand it to cover broader marine resource stewardship following completion of the MPA planning phase
- Establish an independent budget for the Commission

No specific recommendation among these options, and others which can be developed, is offered in this draft report. Whatever changes are made must result from interactions among the Commission, the Legislature, the Department, and other interests. Any addition of capacity will require resources that are challenging to identify given the state's current and likely future fiscal situation. For this reason, any capacity proposal must identify a source of ongoing funding, including the possibility of a fee imposed for all use of marine resources.

Recommendation 6: Redirect resources devoted to individual fishing permit issues.⁶³

One consequence of policy fragmentation is the complexity and inconsistency of license and permit frameworks for different fisheries. For example, the rules for permit transfers are not consistent across fisheries, and the lack of consistency creates confusion and unnecessarily increases time demands on DFG staff. In conjunction with the FGC, DFG should develop and implement a program that significantly reduces the overall resource demands associated with marine fishery permitting, including appeals.⁶⁴ The program should simplify, clarify, and bring consistency to license and permit terms and requirements. The intent of this program is to allow DFG to devote more resources to developing its internal science capacities and focusing on MLMA implementation programs including data-gathering, FMP development, and support for pilot programs to evaluate co-management. An additional policy goal is to keep commercial fishing licenses among active fishers and reduce the use of those licenses as valued components of an "investment portfolio" by individuals not actively fishing, behaviors which make management more difficult and divert Commission and DFG resources from their core missions.

Action should be pursued to focus the energy and resources of DFG and the Commission on broader marine resource policy and away from actions affecting only individual resource users. To the extent initial steps to shift responsibilities have been taken by the FGC, these should be supported and further steps identified and pursued. Other agencies in California have experience with Administrative Law Judges or other approaches for similar roles, and other states have addressed relationships with

⁶³ It is beyond the scope of this report to present a broad evaluation of Marine Region organization, staffing, and management. That said, it is clear that MLMA implementation is affected by a basic lack of resources, including staff. This report offers a single specific recommendation for increasing available staff resources. One step that merits attention is a re-organization of DFG that establishes the Marine Region as a division reporting to the Director, rather than as one of seven regions. The Marine Region simply is not like other terrestrial regions in the state: it covers the entire 1,100 miles of coast, includes extensive commercial and recreational activity and tourism, and faces direct impacts from ocean change. Interviews and research suggest that its needs are not well understood or, more importantly, addressed under the current DFG organization.

⁶⁴ See, e.g., FGC §§ 7852.2, 7853; and 7857-58.

individual resource users differently. To the extent legislation may be required this need should be identified immediately and made part of the overall strategy for achieving significant efficiencies.

Recommendation 7: Convert to electronic record keeping for all fisheries data.

DFG should develop an approach to convert all fishery data collection and record keeping to electronic format, including permits and licenses. This approach should include potential solutions to barriers posed by state procurement systems. This approach should be developed in consultation with the FGC.

Recommendation 8: DFG and the FGC should clearly articulate policy regarding MPAs and fisheries.

None of the three state FMPs consider how to integrate Marine Protected Areas (MPAs) into fishery management. As the network of MPAs is established and protection of identified areas begins, it is timely to directly address how MPAs will affect fisheries management actions. The NFMP identifies MPAs as a primary means of conserving essential fish habitat but provides no real guidance on how existence of MPAs affects fisheries management.

Managers and fishery participants need to be clear about whether fish within MPAs are to be considered part of the fishable stock or whether these subpopulations are to be excluded from stock assessments and setting of Total Allowable Catch or other limits to support precaution or more robust management. A workshop to discuss the implications of various policy options may help clarify the choices. The timing and content of such a workshop should support, and not disrupt, the MLPA planning process.⁶⁵ Once the policy is clarified, DFG should task a technical advisory committee with developing recommendations for how management models and decisions should take account of the presence of MPAs.

Competent implementation

Recommendation 9: Set a clear timetable and specify the resources necessary to gather Essential Fishery Information(EFI). Define preferred stock assessment model(s) and link EFI needs to data required to implement the stock assessment model so that management needs are met in an efficient manner. Link this work to the management plan described in Recommendation 1.

DFG is challenged to assemble a database of EFI for each species managed by the state. EFI establishes a benchmark for the scientific data required for effective fishery management. The Master Plan provided a list of variables that constitute EFI, which included socioeconomic variables. The Master

⁶⁵ In particular, this recommendation is not a criticism of the MLPA approach to design of new MPAs.

Plan also scored fisheries as data poor, data moderate or data rich. Most state fisheries were data poor, indicating that there were major gaps in EFI. Formal stock assessment was not possible, indicating a need for strong precautionary management. The FMPs that have been completed include research programs to gather EFI but no timetable for gathering these data and moving species from data-poor to data moderate or data rich. There is a mixed record at imposing some form of precautionary management on most species reflecting their data poor state. DFG has assembled data to move some species into the data moderate class. But progress in building a base of EFI for most species is slow.

Recommendation 10: Clarify the Ecosystem Based Management (EBM) model and how it relates to EFI, habitat protection/restoration, and fishery management. Some basic ecosystem thinking could be incorporated into FMPs and all fisheries management actions during routine status reporting, such as food web diagrams to identify predator prey relationships, which may impact other fisheries, and any known relationships between ocean climate cycles and species productivity that may impact future yields.

The MLMA set a new direction for fishery management, emphasizing long term sustainable fisheries over short-term harvest oriented management. Under the MLMA, fishery management was to be part of the overall management of marine ecosystems to ensure both sustainable fisheries and healthy marine ecosystems. MLMA prescribes EBM to achieve this goal. The intent to move toward EBM is affirmed in FMPs, but none of the documents state what EBM means and how it will affect management. The NFMP lists a number of possible indicators of fishery effects on the ecosystem but does not provide any conceptual model or framework that would connect these variables with fish production or management. Without these kinds of organizing frameworks it is difficult to assess how management will proceed, whether it will be sustainable, and how the management system will respond to future changes.

Recommendation 11: Continue the policy of peer review of FMPs and other important management actions. Experience from past peer reviews should be used to streamline the process to ensure the most efficient use of both reviewers' and DFG staff time. The CALFED science program established a process that has worked reasonably well and DFG could use experience from this program to help improve its own peer review process.

MLMA and the Master Plan established that FMPs would be subject to peer review. This is an important advance in the use of scientific expertise in fisheries management. Reviews of the WSB FMP and NFMP suffered from delays in plan preparation and time constraints and uncertainty about how best to proceed. However, the reviews did help legitimize the scientific basis of the FMPs.

Recommendation 12: DFG needs to regain some of its lost stature as an organization that runs on a foundation of good science as this will enhance its credibility as a management organization.

DFG needs to reaffirm the importance of science in sustainable fishery management and the Department's commitment to obtaining good science. At least some staff with the ability and training to undertake good science should be protected from the demands of other management duties and allowed the opportunity to conduct science relevant to implementation of the MLMA, perhaps as leaders of collaborative research teams involving other agencies (e.g., National Marine Fisheries Service) and academics. The successful history of engaging with academics to fill gaps in EFI should be more vigorously pursued and where feasible should be extended to engage fishers and other interest groups.

Sustainable use of living marine resources, measured systematically

Recommendation 13: DFG (in collaboration with the OPC and the FGC) should organize a series of workshops offered by academics and practitioners knowledgeable about effectively incorporating science and information and new policy tools into fisheries management. Existing approaches in California (e.g., CALFED Science Program and Independent Science Program, MPA Monitoring Enterprise) should be examined for lessons. Personnel at all levels within DFG, the FGC and OPC should be encouraged to participate in these workshops.

A key lesson learned from this report is that evidence of sustainable fishery and marine resource management is mixed at best, and does not support a claim of success that can be measured across many species. In too many cases, information required to make a robust judgment regarding sustainability is missing. In some cases species are in decline and current management tools have not yet returned them to sustainable levels. With a limited and shrinking resource base, DFG has been struggling to meet the challenge of day-to-day management under the MLMA and other fisheries management legislation. The FGC equally struggles in its marine policy making and regulatory roles under the MLMA, in part due to information issues. The OPC does not have direct roles in fisheries management but will benefit from increased understanding of fisheries management. Phipps et al. (nd) state that: "Conventional data collection and stock assessment methods, which require large amounts of time and resources, have become a bottleneck in California Fishery Management Plan (FMP) implementation, and in the transition of fisheries to science-based management." DFG is open to alternative methods that are less time- and resource-intensive but these must still meet stiff quantitative requirements. This is not only a bottleneck for traditional species-focused management. Expanding the context to include socio-economic considerations and EBM creates additional data bottlenecks. OPC includes information and science roles in its activities, but its authorizing legislation does not clearly link those competencies to support of management of living marine resources through the authority of the Commission and the Department.

California is not unique in facing the challenges of incorporating improved information and science to support new tools in managing living marine resources. California is also not unique in having

limited budgets and personnel and needing to make hard choices about strategic use of management tools. Investments in learning from others can have substantial benefit. This effort should be considered as on-going, but with annual review to ensure relevance and effectiveness as part of the management plan described in Recommendation 1.

Understanding of relevant physical, biological and human systems

Recommendation 14: Fisheries management actions should identify quantitative and conceptual models that underlie management now and in the future. These models should be used to structure the research program to ensure that the needs of assessment and, ultimately, ecosystem models are satisfied in an efficient way.

Mathematical stock assessment models that provide estimates of yield from data on catch, effort, age structure and growth are fundamental to traditional fishery management. The structure of these models differs among kinds of fisheries (e.g., finfish, shellfish, and crustaceans) but there are well-established models for most kinds of fisheries. Ecosystem-based models that link harvested species to their habitat and to other species in the community can enrich both single-species management and multispecies management. These models provide structure to fishery management science; however, the models were not used explicitly to inform the research programs identified in FMPs.

Recommendation 15: Fishery management actions should include explicit consideration of how the broad range of habitat alterations that human activities cause in coastal waters (including estuaries and coastal marshes) are likely to impact productivity of commercial and recreational fisheries and offer ways to mitigate those impacts.

Recommendation 16: DFG should establish a technical advisory committee and initiate a series of workshops to assess the implications of both cyclical and long-term changes in ocean conditions on California fish stocks and how knowledge of these effects could be incorporated into management. CalCOFI could be a good framework for assembling such a series of workshops, because it has long been a focus for the analysis of ocean climate variation and its effect on the marine biota of California. The CalCOFI Symposium in 2009 addresses "Forecasting Fishery Productivity in the California Current," which could be an excellent starting point for workshops.

Recommendation 17: Successful co-management of fisheries requires a high degree of trust and respect between fishers and managers. At present the necessary trust and respect appears to be lacking in most fisheries. DFG should take the initiative to develop pilot projects in collaborative data gathering and other aspects of fishery management with willing fishers as a step toward developing the necessary trust and respect.

The MLMA and Master Plan promote a collegial and collaborative approach to FMP development and implementation through constituent involvement. DFG, however, appears to interpret constituent involvement rather narrowly as a consultative process with DFG firmly in control. The NFMP

describes a number of successful and beneficial projects in which managers, academics and fishers worked together and suggests that more such projects would be a good idea but does not identify any particular candidate projects. Benefits of fisher's knowledge and fleet infrastructure in management as well as the engagement of fishers as part of the process are important components of effective resources management. Ultimately, collaborative research and management provide a way to enhance effectiveness of management and possibly to also reduce costs. Moreover, California has valuable successful experiences on which to build and many other fisheries around the world have also made progress in developing trust and respect among fishers and managers which can be a basis for changed practices in California.

Recommendation 18: The OPC, in consultation with the Ocean Trust, the FGC, DFG, and the Science Advisory Team of the MLPA, should establish a committee to initiate the process of developing a comprehensive research strategy for the California Current Large Marine Ecosystem. The strategy should engage with the marine research infrastructure in Oregon and Washington to develop an inclusive research program as envisioned in the WCGA.

The coast of California falls within the larger California Current Large Marine Ecosystem. As Halpern et al. (2009) have shown, this ecosystem is heavily impacted by a broad array of human activities and is highly sensitive to impending climate change. The West Coast Governors Agreement on Ocean Health (WCGA 2006) called for collaborative action on research and education and coordinated management to address regional issues in the California Current. It is time to take a more vigorous approach to implementing the WCGA.

Understanding of relevant institutional, policy and management tools

Recommendation 19: DFG should convene an advisory committee of social scientists, including economists and social anthropologists, to develop a strategy and a plan for defining essential socioeconomic information and how it can be used in management of fisheries. This should be done within the context of continuing budget constraints and the role that social and economic considerations are expected to play in sustainable fisheries. An initial workshop might be followed up by a pilot project (funded through Sea Grant or other appropriate mechanism) to test the ultimate cost and usefulness of socioeconomic EFI in fishery management.

Socioeconomic data are virtually non-existent for most fisheries and current FMPs do not provide much insight into the social and economic aspects of fishing. The NFMP identifies a list of socioeconomic EFI and suggests some ways these data could be used but does not provide a model or framework for prioritizing socioeconomic data or for incorporating the results of socioeconomic analyses into fishery management. If regional management is to become a reality, better understanding of socioeconomics will be necessary in order to achieve the "fairness" principles in the MLMA.

Taking the next big step: Integrated management of living marine resources

California can improve implementation of the MLMA, largely by more effective focus of existing resources and authority, and recommendations regarding such improvements are given above. Making progress on these recommendations will improve California's management of living marine resources. A more ambitious agenda can be imagined in response to a broader question:

"How can California move from its current situation of considerable successes, but also challenges, in achieving the goal of sustainable use of living marine resources, to clear world leadership in this important effort?"

In short, instead of focusing on implementing the MLMA narrowly, or even the full set of existing management tools, ask what is needed for successful management of living marine resources across two or three generations of Californians.

One approach would be to move toward integrated resource management. Current institutions, policies, programs, and even science efforts are characterized by fragmentation and modest efforts to understand and manage interrelationships. This is not a call for "tight" control over any current policy making body, program or science enterprise. In contexts of complexity, uncertainty and high levels of change (certainly attributes of living marine resources), systems characterized by organizational fragmentation but high levels of transparency and interaction, working on a foundation of resource allocation directed to achieving desired results, are usually most nimble and effective.

When assessed in terms of long-term capacity along these lines, California has some important building blocks in place already and next steps can be identified. From this assessment it is clear, however, that if California policy makers choose to engage policy making more broadly, they should give high priority to building institutional capacity.

Appendix 1: Science and the MLMA

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Introduction:

Science has been the foundation of fishery management for more than a century. As ecological theory and methods of analyzing the dynamics of populations using mathematical models developed in the first half of the 20th century, these methods began to be applied to fisheries. Ray Beverton and Sydney Holt (1957) published their famous model of fish populations under exploitation in 1957 and Bill Ricker (1954) published his famous article on stock and recruitment in 1954. These models and their associated ecological theory form the basis of most fish stock assessment models. Early stock assessment models (surplus production models, e.g., Schaefer 1954) allowed estimates of Maximum Yield from fishery dependent data (catch and fishing effort) and age structured models (dynamic pool models, cohort analysis, e.g., Pope 1972) incorporated age and/or growth into yield estimation. Recent models are more sophisticated in that they provide explicit estimates of uncertainty in parameters and can incorporate some types of environmental information. But at their core there is still a stock and recruitment function of either the Beverton and Holt or Ricker type. As fishery management policy has evolved from maximizing yield to optimizing societal benefits from fishing and from a focus on individual fish species to a concern for marine ecosystem function, these tools for assessing the status of fish stocks and determining sustainable harvests have remained central to effective fishery management. Economic models of fisheries, for example, depend on these kinds of fishery yield models to provide a supply function (e.g., Clark 1990)

The MLMA places considerable emphasis on the importance of good science to effective fishery management. As summarized by Weber and Heneman (2000):

"Fishery management decisions are to be based on the best available scientific and other relevant information, including what the MLMA calls essential fishery information. Essential fishery information includes the biology of fish, population status and trends, fishing effort, catch levels, and impacts of fishing" [93].

"The MLMA calls upon the Department to collect essential fishery information for all marine fisheries managed by the State [7060(a) and (b)]." (22)

Under the MLMA, the foundation of fishery management is to be the Fishery Management Plan (FMP). From a science perspective, FMPs are to:

- summarize the best available scientific and other relevant information regarding the effects of management measures on fish populations and habitats, fishermen, and coastal communities [7083(b)];
- rely on such information in identifying measures that might minimize damage to habitat from

fishing [7084(a)];

- summarize the best available scientific information on such things as level of by-catch and its effects on other fisheries, the conservation of by-catch species, and the ecosystem [7085];
- draw on such information when identifying criteria for determining when a fishery is overfished [7086(a)];
- have the scientific basis for management documents reviewed by a panel of external experts [7062(a)].

However, the MLMA is concerned with more than fishery management. It recognizes that healthy fisheries depend on healthy marine ecosystems and protection of fishery habitat:

"The MLMA also recognizes that research and an understanding of marine life are essential to making good decisions about our stewardship of marine living resources. As a result, the MLMA promotes the use of scientific information about the lives and needs of marine plants and animals." (Weber and Heneman, 2000, 9)

With regard to ecosystems, the MLMA establishes the following goals, all of which depend on scientific understanding of marine ecosystems:

- **Conserve Entire Systems:** It is not simply exploited populations of marine life that are to be conserved, but the species and habitats that make up the ecosystem of which they are a part [7050(b)(1)];
- **Non-Consumptive Values:** Marine life need not be consumed to provide important benefits to people, including aesthetic and recreational enjoyment as well as scientific study and education [7050(a)];
- **Habitat Conservation:** The habitat of marine wildlife is to be maintained, restored or enhanced, and any damage from fishing practices is to be minimized [7055(b); 7056(b)].

In this report we summarize information on progress toward all these scientific goals and offer comments and suggestions concerning how DFG could increase scientific understanding of ecosystems and the fishery resource and improve the way it uses science in management. The report is based on review of relevant documents and interviews with knowledgeable individuals from government, industry, and academia.

Science and the Master Plan:

The MLMA prescribed that a Master Plan and FMPs for White Sea Bass and Near Shore Finfish be prepared within a few years of passage of the Act. The purpose of the Master Plan was to list and prioritize California fisheries for preparation of FMPs and provide guidance on costs, actions and timelines for plan preparation. From a science perspective, the MLMA also required the Master Plan to describe current research and monitoring of each fishery and any additional research needed to obtain essential fishery information (EFI).

The prioritization of species for development of FMPs is one of the strongest sections of the Master Plan. The long list of species for which the State has management responsibility is developed and validated with assistance from numerous outside experts. Methods of fishery prioritization were reviewed and a list of criteria was developed for California fisheries. The preliminary prioritization ap-

proach was sent to marine fishery experts for review and finally separate approaches for finfish (two different approaches), invertebrates and marine algae were chosen. Species were analyzed and ranked in terms of priority for developing and FMP within categories (finfish, invertebrates, algae) and a final subjective assessment made to select the top ranked species. The approach was logical, drew on external expertise for validation, and made good use of available science. Unfortunately, there has been little follow through as only three FMPs (white sea bass, near shore finfish, market squid) and one conservation plan (abalone) have been developed since passage of the MLMA.

EFI is an important science concept in the MLMA as it establishes a benchmark for the scientific information needed to manage fisheries. According to the Fish and Game Code, “Essential fishery information” means information about fish life history and habitat requirements; the status and trends of fish populations, fishing effort, and catch levels; fishery effects on fish age structure and on other marine living resources and users, and any other information related to the biology of a fish species or to taking in the fishery that is necessary to permit fisheries to be managed according to the FGC. The Master Plan elaborates this definition to provide a list that includes both biological and socioeconomic variables:

Biological EFI

Age and growth
Stock distribution
Ecological interactions
Indices of abundance
Movement patterns
Recruitment
Reproduction
Total mortality
Habitat

Socioeconomic EFI

Employment
Expenditures
Resource demand
Revenue
User/industry demographics

Existing information can be compared against this list to determine how well understood a fishery is and what additional information is needed to fill gaps in EFI. Curiously, the list does not include either catch or effort (unless catch is subsumed under "indices of abundance"), yet these are often the only fishery dependent data routinely collected. It may have been assumed that, since catch and effort are routinely collected from most fisheries there was no need to list them. The list also does not list stock size, which is often estimated from other variables, such as catch and effort, as a part of stock assessment models, but which can also be estimated directly from fishery-independent data in some fisheries.

Using these variables (but collapsing socioeconomic variables into one category) the Master Plan scored fisheries as data rich (able to proceed with confidence in developing a FMP), data moderate (able to proceed with some confidence in developing a FMP), and data poor (unable to proceed with any confidence in developing a FMP). Based on this scoring only the two species of kelp had a majority of biological variables in the data rich category. Among the remaining fisheries, only California halibut was reasonably well known biologically, with 4 variables in the data rich category and 4 in the data moderate category. Socioeconomic variables were data poor for all fisheries. This and other analyses indicate that the data for most California fisheries is inadequate for preparation of a FMP of the sort envisioned in the Master Plan’s interpretation of the MLMA. Considerable research effort will be required before Califor-

nia will achieve even a data moderate status for many of its fisheries. Although the Master Plan dismisses preparation of FMPs for data poor fisheries, FMPs could still be developed for these fisheries as a means of formalizing the scientific basis of interim precautionary management and of specifying research needs to move these species into the data-moderate class.

The MLMA requires the conservation of whole ecosystems, supports research on marine ecosystems and speaks of the need for an ecosystem perspective but does not define what this means. The Master Plan states that California is committed to and is moving toward ecosystem based management but does not specify what this means. FMPs are to include ecosystem guidelines but these are left to be decided in the context of each plan. One goal of the White Sea Bass FMP is to move toward ecosystem based management but the FMP does not say what this means, except to note that it will involve understanding the relationship between bass and their prey. Similarly, the Near Shore Fishery Management Plan recognizes the need for managing in an ecosystem context but does not suggest what this means in terms of either EFI or management actions. California appears to be struggling to come to grips with the concept of ecosystem based management. Yet a considerable literature exists in fisheries science and other areas of resource management that provides useful guidelines for structuring ecosystem based management (e.g., Boyce and Haney 1997, Pikitch et al. 2004, Boesch 2006). If California really intends to move toward ecosystem based management it needs to be clear about what this means in the California context and lay out a framework for such management, including information needs.

Adaptive management is one of four general policies given in the MLMA for achieving its conservation goals (Weber and Heneman 2000). It is defined in the glossary of terms in the Master Plan as a scientific policy that seeks to improve management, particularly in areas of scientific uncertainty, by treating program actions as tools for learning. Actions are to be designed so that even if they fail, they will provide useful information for future actions. Monitoring and evaluation are to be emphasized so that the interaction of different elements within the system can be better understood. Adaptive management is briefly mentioned in relation to plan implementation and opportunity for public input. Yet the Master Plan does not give any guidance about how adaptive management could or should be integrated into fishery management. Nor do the fishery management plans address this issue. In fact, the way that adaptive management is spoken about in the plans suggests that the authors did not fully understand the elements and application of this tool. Adaptive management is a powerful tool for increasing understanding of fish population and ecosystem dynamics (Walters 1986, Lee 1993). However, given the limitations on staff and resources present in DFG, it seems likely that adaptive management could be successfully used only in collaboration with fishers and other research organizations. The Master Plan places considerable emphasis on collaboration in all phases of fishery management including the gathering of EFI. Collaboration on adaptive management experiments is, therefore, well within the context of the Master Plan.

As with ecosystem based management, the Master Plan discusses habitat issues only in very general terms. None of the EFI specifically addresses habitat issues. Yet the 2001 report on the status of California's living marine resources describes considerable degradation of near shore habitats, both physically and chemically (Leet et al. 2001). The status report states, for example, that:

"...existing data indicate that uses of 100 percent of the State's surveyed tidal wetlands, 71 percent of surveyed bays and harbors, 91 percent of surveyed estuaries, 78 percent of surveyed freshwater wetlands, 71 percent of surveyed lakes and reservoirs, and 81 percent of surveyed rivers and streams are impaired or threatened in some way by water pollution." (Leet et al.

2001, 29)

Physical loss of habitat is also a significant problem. Coastwide estimates of habitat loss were not given but the status report notes:

"90 percent of California's coastal wetlands have been diked, paved over, developed or otherwise destroyed, and only five percent of the State's coastal wetlands remain intact." (Leet et al. 2001, 35)

Near shore habitats of all sorts are critical nursery areas for many marine species and when these habitats are impaired species productivity is also likely to be impaired. In our view, the science needs of habitat assessment and restoration deserved greater emphasis in the Master Plan.

Recently, Halpern et al. (2009) examined the cumulative impact of human activities on the California Coastal Current ecosystem and concluded that the ecosystem is heavily impacted with greatest impacts near major population concentrations and in coastal waters of Washington and Oregon. Impacts tended to extend further offshore off California than off Washington and Oregon. Maps of cumulative human impact, such as those provided by Halpern et al. (2009), help identify critical areas for conservation and signal the importance of a broadly based consideration of habitat impacts on marine ecosystem productivity.

Numerous exogenous variables affect fisheries. Among the most important of these are climate fluctuations, which can drive the abundance of a fish species up or down. Some recurrent features of ocean climate, such as El Niño/La Niña fluctuations and the Pacific Decadal Oscillation are well recognized to affect the abundance of certain species. Coastal upwelling in the California Current system, driven by summertime north or northwesterly winds, is a major factor in the high productivity of the region. Some years ago, Andrew Bakun (1990) speculated that global warming might strengthen this upwelling process and recent modeling of regional climate effects has supported this conjecture (Snyder et al. 2003). The implications of such a change in the coastal ocean is uncertain as upwelling enhances local plankton production but also disperses plankton, potentially reducing its availability as food, and pushes pelagic fish larvae offshore, away from coastal nursery habitat. Considerable additional research is needed to understand the overall response of the California current system to global warming.

Also missing from the Master Plan is any consideration of how to integrate Marine Protected Areas (MPA) into fishery management. The sizes and locations of MPAs are being decided without much consideration of their impact on fishery management. However, MPAs will provide refugia for some commercial species and exclude fishermen from significant areas of the coastal ocean. MPAs provide both opportunities and difficulties in the scientific management of fisheries and it would have been helpful if the Master Plan had provided some guidance as to how MPAs could contribute to achieving the broad goals of the MLMA and be integrated into the fishery management system. Understanding the implications of MPAs for harvested species requires considerable understanding of the biology, ecology and movement patterns of the species. Given the data poor nature of most California marine species, it may not be possible to modify management in relation to MPAs without considerable additional research.

Like the MLMA, therefore, the Master Plan emphasizes the importance of good science in effective management and promotes an open and collaborative approach to all aspects of fishery management, including science. It demonstrates this approach in the way it prioritized fisheries for develop-

ment of FMPs. There are, however, some weaknesses in the Master Plan in relation to science needs to meet the broad goals of the MLMA. The concept of essential fishery information is elaborated in that the Master Plan provides a list of biological and socioeconomic variables that would constitute EFI. However, the Master Plan does not discuss EFI in relation to any of the traditional stock assessment models to illustrate more explicitly how data rich, data moderate and data poor fisheries differ in their scientific foundation. Furthermore, since most CA fisheries appear to fall into the "data poor" category, the Master Plan did not provide any suggestions as to how these fisheries should be managed until such time as they can be brought into the data "moderate category". Fishery management plans have addressed this problem by using the subjective rules proposed by Restrepo et al. (1998, see also Restrepo and Powers 1999). However, the Master Plan suggests that FMPs cannot be pursued in data poor fisheries. By contrast, we believe that FMPs should be used to focus research needs and formalize provisional management for these fisheries. The Master Plan is very weak in the guidance it provides about ecosystem based management, habitat conservation and adaptive management, three concepts that have significant science implications. Clear guidance on how these concepts and their associated tools should be integrated into marine life conservation and fishery management is needed if they are to become more than mere buzz words. Finally, the Master Plan is silent on the existence of and the implications of the MLPA and MPAs for achieving the broad goals of the MLMA, for improving fishery management and for the science needed to realize any benefits of MPAs.

Science and Fishery Management Plans:

Fishery management plans were to include a description of the state of knowledge of the fishery and a research plan identifying gaps in EFI and how these gaps would be filled. Here we discuss primarily the two plans mandated under the MLMA, the white sea bass plan and the near shore finfish plan.

White sea bass plan.

A white sea bass plan was drafted prior to passage of the MLMA and the plan developed under the MLMA was an amended version of the earlier plan. It does not, therefore, correspond precisely to the structure and requirements laid out in the MLMA. Nevertheless, the plan was ultimately approved under the umbrella of the MLMA and it provides one example of the use of science in FMP development. As required under the MLMA, the white sea bass FMP provides a summary of existing biological and socioeconomic knowledge of white sea bass and its fisheries and a discussion of information needs to fill gaps in EFI. The data base for fishery management is primarily from fishery dependent surveys and these data are well presented and analyzed. However, as the FMP acknowledges, many of the data have problems of consistency and accuracy. MacCall et al. (1976) performed a stock assessment on data available in the 1970s and Dayton and MacCall (1992) estimated unfished biomass. However, no recent assessment of stock status has been conducted and, given data problems, any assessment is likely to be very uncertain. For the purposes of the plan, Optimum Yield was estimated from the Dayton and MacCall (1992) estimate of unfished biomass and from catch histories over various periods. These estimates are treated conservatively but, presumably based on the conclusion that the stock was above MSY, the preferred alternative was one of the highest OY estimates. The peer review of the plan questioned the conclusion that the stock was above that for MSY.

As required under the MLMA, a draft of the white sea bass plan was subject to an external peer

review. The peer reviews of this and the near shore fishery management plan (to be discussed below) were organized with the assistance of the California Sea Grant Extension Office and were the first such reviews experienced by DFG and the FGC. Not surprisingly, there was some confusion and dissatisfaction with the process both by the reviewers and the government agencies (Leet et al. 2002). Peer review is an important tool for ensuring that the best available science is used in an objective way in the FMPs and, to its credit, the FGC took the review comments seriously, delaying plan approval until DFG addressed the concerns of the review panel.

Peer review can only identify weaknesses in data and analyses, however. Improving the analyses on which plans are based usually requires additional data. The white sea bass plan identifies many gaps in EFI and prioritizes the data and analyses needed to improve fishery management. Research needs are divided into short and longer term. Short term needs focused on getting a stock assessment conducted, improving information for more sophisticated stock assessments, assessing by-catch, and evaluating current regulations. Longer term research needs focused on developing new assessment techniques that incorporate environmental data, understanding ecosystem issues, improving hatchery performance, socioeconomic issues and cooperative research with Mexico. Information needs are discussed in relation to nine broad groupings of EFI and deficiencies in existing data related to each grouping. This structure is logical but not connected to a well developed management model into which the data would fit and carry management toward a particular set of objectives. Data needs are discussed in rather broad general terms rather than in terms specific to the characteristics of white sea bass and any preferred management model. This makes it difficult to assess whether the priorities established for data gathering make sense.

Constituent involvement is highlighted in the MLMA as a means to extend the capacity of DFG to gather fishery related information. Although the white sea bass FMP repeats this need for constituent involvement it tends to interpret it narrowly as communication and consultation rather than as open collaboration in all aspects of fishery management, including research to fill gaps in EFI. Yet, in a time of reduced budgets collaborative research can be a means to enhance research capacity.

Section 9 of the white sea bass FMP includes a discussion of the many coastal water quality and physical habitat alterations caused by humans in the coastal environment that could affect productivity of white sea bass, ranging from coastal development to contaminants from marine transport and from urban wastewater to invasive species. However, the FMP does not speculate about the extent to which such changes may have impaired the productivity of white sea bass. Nor does the FMP offer any suggestions about how to halt and reverse these impacts. These human caused changes to marine habitats and the marine environment are important to the broad ecosystem health objectives of the MLMA and need fuller examination and analysis. One could question whether these factors should be part of a fishery management plan. However, habitat protection and restoration are part of the way that fishery management is envisioned in the MLMA. Ecosystem based management (EBM) is another part of the MLMA that gets limited discussion in the white sea bass FMP. Limited data and limited practical tools are the principal reasons for pushing ecosystem based management into the distant future. There seems also to be a suggestion that EBM will require hugely complex detailed models, which may be completely self defeating. Without a plan for how the science will be developed and incorporated step by step it is unlikely that management will truly evolve toward EBM.

Near Shore Fishery Management Plan

The *NFMP* was very ambitious in concept and brought together many experts to ensure that the best available science formed the foundation of the plan. Unfortunately, all of the 19 species covered by the plan fell into the "*data poor*" category. Some were also at low abundance, but with the lack of data and analysis, it was difficult to determine even this for many of the species. As a result, formal stock assessments could not be done and precautionary management had to be adopted.

As with the white sea bass FMP, the data base for management of near shore finfish is primarily from fishery dependent surveys and these data are well summarized. However, echoing the white sea bass FMP, many of these data have problems of consistency and accuracy. Looking to the future, the *NFMP* established three stages or levels of management based on increasing understanding of species biology. At stage I, all species are data poor and precautionary rules govern harvest control rules. As this was the status of all 19 species at the time of writing the *NFMP*, proxy measures of MSY based on catch histories were used to develop harvest control rules. Following the lead of the PFMC, TACs were set at 50% of the proxy MSYs to ensure that stocks would rebuild. Where species could only be harvested together (e.g. rockfish), a pooled TAC was set taking account of the weakest of species in the group. Stage I management is undesirable for many reasons, not least because it is difficult to assess the effectiveness of regulation, so a critical aspect of Stage I management must be improving the data base so that stage II management can be implemented. At stage II (data-moderate), formal stock assessments are possible and precaution can be relaxed if abundance warrants. As a result of improved data collection, six of the near shore species have moved into the data-moderate category (California scorpionfish, gopher rockfish, black rockfish, blue rockfish, cabezon, and greenling). At stage III (all species are data-rich), ecosystem based management is possible.

The *NFMP* also includes an ambitious program of data gathering and research so that over time all species will graduate to the data moderate and data rich categories. According to the plan, during Stage I management research should be focused in seven areas:

1. Improving the accuracy and completeness of the fishery dependent data base and subsequent analyses and improve geo-referencing of catch locations;
2. Implementing fishery-independent surveys of abundance and density;
3. Augmenting life history and population data so that changes with time and environmental conditions can be tracked;
4. Selecting study areas in each region that vary in fishing effort and initiate comparative studies;
5. Mapping of near shore habitats in high resolution;
6. Assessing survival of discards;
7. Developing and improving ecosystem information (such as food web studies and physical oceanographic information) for eventual incorporation into fishery models.

The long term goal of all this data gathering is to progress toward ecosystem based management (Stage III). The transition from Stage II (species focused management) to Stage III (ecosystem based management) depends on meeting two conditions:

1. Understanding how fishing affects the food web and other aspects of ecosystem function (as determined from comparison of areas subject to different intensity of fishing);

2. Understanding how changes in oceanographic conditions (e.g., El Niño, climate change) affect fishery productivity.

Once these conditions are met, Stage III management will allow managers to adjust harvests to maintain desired ecosystem function and respond proactively to anticipated changes in fish productivity. The *NFMP* also lists a number of measurable ecosystem properties that could provide indicators of fishery effects on the ecosystem including: trophic position; food web connectivity; and species richness as well as oceanographic properties like El Niño and sea surface temperature that are known to affect fish production. The *NFMP* acknowledges that achieving Stage III management will be a complex and challenging process. Stage III management also depends on the success of MPAs as reference ecosystems in which populations grow to unfished abundance.

As indicated above, the *NFMP* provides a much more detailed description of science in support of ecosystem based management than the white sea bass FMP. However, the plan fails to show clearly how ecosystem variables will affect management. Missing is an ecosystem model sustaining the target fish species that illustrates how the various ecosystem variables affect harvested species and could thus inform management. Many of the variables may be considered indicators of "ecosystem health" but this concept is largely a human construct. Consider some of the variables listed in the plan. What trophic position is desired, what species richness, what food web connectivity? How much change in these variables is acceptable? It is not clear that the reference conditions in MPAs will clarify these questions. A conceptual ecosystem model would help clarify these issues and help prioritize variables to be measured.

The *NFMP* proposes regional management, which greatly increases the level of scientific detail needed. Determining the number of regions, the degree of separation between populations occupying each region, the extent to which populations differ in productivity and dynamics and the degree to which management should differ among regions are all issues demanding scientific input. Using existing data on stocks, landings and oceanographic conditions the plan proposes managing on the basis of four regions. Regional fishery management has not been implemented as costs and data requirements have been considered too high at this stage (i.e., estimated double present costs and 3 times present staff). Although regional management makes sense for species that are not highly migratory, the information needs are much greater than for coastwide management. The *NFMP* research plan is correspondingly complex and includes a number of innovative features connected with regionalized management: geo-referencing all data; mapping near shore habitats using GIS; and genetic and tagging studies to map distribution of stock components. In the short term, the plan emphasizes studies to compare areas subject to different fishing intensity. This comparison is expected to permit regional evaluation of management measures, allow researchers to distinguish between natural and human-induced change, and reveal complex direct and indirect effects of fisheries on the near shore environment. All these results will not only facilitate regional management but contribute to the long term goal of ecosystem based management. To date, little progress has been made in gathering these data.

In the *NFMP*, habitat conservation centers on the creation of MPAs. The plan does not identify specific MPAs to support near shore fish species but provides criteria for MPA selection that would ensure the conservation of critical habitat for near shore fishes. MPAs would also provide the non-fishery and ecosystem benefits that were mandates of the MLMA. Benefits listed in the plan include:

1. Protection for representative and unique marine habitats, ecological processes, and populations of interest.
2. A buffer against environmental fluctuations that affect recruitment and against uncertainties in fisheries management.
3. Provide a reference against which to assess fishery impacts.
4. Protect marine natural heritage which includes the aesthetic and non-consumptive values of California's living marine resources.

By whatever criteria MPAs are established they will provide many of these benefits. However, the process for selecting MPAs under the MLPA excludes specific consideration of their benefits for fisheries (SAT 2009, Koch 2009). Fishery managers cannot count on the MPA network to address their habitat or reference area needs. Additional measures and research will be necessary, therefore, to insure that essential habitat for near shore fish is conserved.

Like the white sea bass FMP, the *NFMP* largely ignores near shore habitats and their importance as nursery habitat for near shore finfish. As noted above, coastal habitats have experienced considerable chemical and physical alteration from human activity. Mapping of nursery habitats in conjunction with the proposed mapping of marine reserves and other habitats would help reveal the extent of the problem. The implications of changes in nursery habitats for productivity of near shore species deserve greater scientific attention.

The *NFMP* includes a proposal to collect socio-economic data of various categories including employment, expenditures and fishery costs, resource demand, net economic value and revenue. These data will permit various economic analyses of the fishery but the FMP does not make clear how such analyses will be integrated into management. As with so many other aspects of these management plans, the conceptual models that support the collection and interpretation of the various kinds of socio-economic EFI are not specified. This is not to say that the plan does not describe ways in which the data could be used, because it does. What is not clear is how any particular result would influence management. For example, in describing the analyses that could be based on expenditures and fishery costs the *NFMP* states:

" Each sector's expenditures for raw materials used in producing fishery-related goods or services, together with revenue generated at various levels of output, allow for monitoring economic efficiency. This economic efficiency indicator makes it possible to evaluate the success of the management of a commercial fishery."

Does this mean that economic efficiency is a goal of near shore finfish management? The phrase is not used outside the few paragraphs on socio-economics in the *NFMP* and is also not used in the MLMA or the Master Plan, although both promote economically viable and sustainable fisheries. The Fish and Game Code defines Optimum Yield in part as "MSY reduced by relevant economic, social and ecological factors". Economic efficiency is, of course, an objective of the many fishery rationalization programs that have been implemented in other country's fisheries but has been downplayed to a large degree in US fishery policy. Similar questions arise with respect to other economic measures. This is not to say that a better understanding of fishery economics would not be a benefit to management. Only that the list of potential measurements and analyses is long and a conceptual model of how economic understanding would impact fishery management decisions in a tangible way would help prioritize the research effort.

The research program also notes that collaborative research with fishers and other interests can enhance the value of fishery data. A number of past collaborative projects, most involving volunteer input from constituents, are described briefly. The research plan proposes to look for ways to enhance this kind of collaboration in the future but does not give any specific examples.

The *NFMP* proposes a rich and extensive program of research in support of fishery management. Overall, the program is well structured and imposes important boundaries on the kinds of science that would be most useful in improving near shore finfish management. The plan provides a logical progression in management from precautionary setting of TACs when all fisheries are *data poor* (as they were when the plan was written) to application of quantitative single species (or species assemblage) stock assessments as fisheries graduate to being data-moderate, to highly sophisticated (and largely undefined) ecosystem based management once fisheries become data-rich. The *NFMP* also proposes regional management of the near shore finfish species, which multiplies significantly the scientific requirements of successful management. In addition to a much improved understanding of the biology of the harvested species, regional management will also involve detailed understanding of socio-economics if the "fairness" principles in the MLMA are to be achieved. The proposal for regional management also raises the issue of measurement scale, which is touched on but not explored in detail in the plan. Different species and different life stages of the same species function at different geographical and temporal scales. Planktonic eggs and larvae of some species may be dispersed over a large geographic scale in a relatively short time by the vigorous circulation of the California current but adults of the same species may spend their lives in a single location. Some species may live for decades while others live only a few years. These and other issues of scale have considerable importance to the ultimate design and scientific evaluation of fishery management.

Given the complexity and scale of the information needs to implement the *NFMP* it is hard to imagine much progress being made unless a huge collaborative effort can be mounted with fishers, managers and outside researchers all working together toward the goals of the plan. The *NFMP* places more emphasis on collaborative research and management than the white sea bass plan but does not really elaborate on its importance to the overall success of the *NFMP* and how collaboration could be mobilized. The complexity of the *NFMP* and its research program also cry out for a clear set of conceptual models that show how the many pieces of information interrelate and milestones signaling progress toward the plan's long term goals. Without such models and milestones it is difficult to imagine how decisions about resource allocation will be made. For example, any available DFG resources could easily be completely absorbed in attempts to improve fishery dependent data gathering. Yet, this does not seem to be the intent of the plan. Improving the science on a number of fronts at once will require courage and determination, especially when resources are scarce. A clearer roadmap in the form of a conceptual model might help sustain this process.

Recent MLMA Science:

In this section we summarize some of the scientific activity in support of fisheries management undertaken since the MLMA was enacted. The information is derived primarily from interviews with people knowledgeable about California fisheries. A great deal of marine science is conducted by government, academics and private organizations in California and much of it is relevant to fishery management and the MLMA goal of sustaining California's marine resources. Our summary deals primarily with fishery-related science and how that science gets incorporated into management. Given the great

scientific demands of the MLMA the capacity of DFG and the larger scientific community to provide that science is crucial.

DFG's Capacity for Science.

DFG produces much of the routine scientific and statistical data that it uses for management. Probably most important is its role (sometimes in collaboration with other agencies) in gathering and analyzing fisheries-dependent data, which is often the only source of data on abundance trends and is used as input for statistical stock assessments. DFG has also instituted new programs, such as the California Recreational Fisheries Survey (CRFS) and the new recreational "report cards" for abalone and spiny lobster, as a means to improve the data for species management. The CRFS uses port and shore sampling and telephone surveys of anglers to get information. It was designed to improve on the older MRFSS program. The "report card" programs provide catch and effort data, as well as the geographical locations of catches.

DFG also carries out some fisheries-independent surveys, such as diver surveys to assess abalone abundance in fished and unfished areas. Remotely-operated submersible vehicles (ROVs) are used to assess fish populations in fished and unfished areas as well. Herring populations in San Francisco Bay are estimated by hydro-acoustic surveys and surveys of herring eggs. DFG staffers also conduct research to gather EFI, but it is difficult for us to gauge its extent. Some documents (such as stock assessments) note the inclusion of biological data gathered by DFG personnel, but we do not have a comprehensive view of the work being carried out. DFG personnel also carry out biological studies, such as the study of life history and movement patterns of nearshore rockfish that were published in Fish Bulletin 177: *Biological Aspects of Nearshore Rockfishes from Central California with Notes on Ecologically Related Sport Fishes*. This Fish Bulletin, published in 1999, was the last such publication by the Marine Region, and the second to last in the series to date, which began in 1913. Of the 178 Fish Bulletins published since 1913, only 6 have been published since 1988, which suggests a lessening of research activity. One interviewee, not associated with DFG but familiar with its operations, thought that DFG lacked the financial and intellectual support for extensive original research. Another interviewee noted that DFG had terminated its plans to assemble an "ageing" lab, to determine ages of specimens caught in fisheries and to determine growth rates and ages at maturity.

To further evaluate DFG scientific capabilities we conducted a literature search using the Aquatic Sciences and Fisheries Abstracts, seeking journal articles with first authors listing an address as "California Department of Fish and Game." We found about 28 articles published from 1999 to the present that can be attributed to the Marine Region, about 15 of which were on abalone or sea urchin. Some articles were opportunistic (reporting range extensions, etc.), whereas others reported the results of DFG research and management. This is not a high rate of scientific publication, and may indicate cultural differences among work groups within DFG, or time available to DFG staff in different groups to publish (vs. other responsibilities). The Marine Region Strategic Plan (<http://www.dfg.ca.gov/marine/pdfs/strategicplan2009.pdf>) includes a provision that seeks to encourage publication of scientific findings. One DFG staff person noted that time had to be blocked out in projects for the extra effort to prepare reports for publication in journals.

It is our impression that, at least in the past, some individual DFG staffers became associated with particular fisheries for extended periods of time, becoming experts on the organisms and their fishery, and contributing to the general scientific knowledge of exploited species. Some DFG staffers appear to continue this tradition but, as one interviewee outside of DFG noted, they often have to “fight for” the ability to carry out independent work. We also know that some long-term research programs were terminated after the passage of the MLMA, because of the need to address management, rather than science. One such program was the Central California Marine Sport Fish Survey (Refugia Project), which operated from 1958 to 2006. A lead DFG biologist on this project told one of us (Larson) at the time that the project was being cut back because of the need to address management (the Department was developing FMPs, not conducting science). Other DFG staffers interviewed (and quoted anonymously in the “NFMP debriefing”) noted that mandates, such as the *NFMP* and the MLPA, often required DFG staffers to be pulled from projects in which they were personally invested. The variability of State funding for DFG also influences the amount, quality, and continuity of scientific work carried out by DFG. Programs may be initiated during flush times, but terminated or reduced in scope when times are lean. Because we have so little information at hand, however, we find it difficult to provide a complete evaluation of the degree to which DFG is now developing science.

DFG also depends on scientific information gathered outside of the Department (see below). We have evidence that DFG staffers can be aware of relevant outside research, but that their duties do not allow them to keep abreast of new research on a routine basis. Our cursory review of the DFG web site and some DFG documents (such as stock assessments), as well as some interviews with DFG staff, show that DFG staffers do incorporate new scientific developments produced outside of the Department when they have the opportunity. DFG also participates in workshops, such as the “Managing Data Poor Fisheries” workshop, that help staffers develop new methodologies. To researchers outside the Department, however, it is often not clear how rapidly new developments are being incorporated. But while reports and stock assessments may precipitate review of relevant literature, one DFG staffer interviewed stated that it is up to individuals to keep abreast of scientific developments, and that this requires time spent outside of working hours. Since this is up to individuals, the effort spent varies. This staffer noted that there is an internal initiative within DFG to expand its scientific capacity, but that more support is required for individuals to expand their skills and knowledge (through reading, attending conferences, etc.).

Broadly speaking, the Marine Region staff does not appear to have a high level of quantitative expertise. The Region has a few respected experts in statistics and population dynamics. For example, two DFG staffers serve on the Science and Statistical Committee of the Pacific Fisheries Management Council, at least two groundfish stock assessments have been led by DFG staffers, and the recent California Recreational Fisheries Survey was developed at least in part by DFG statisticians. However, collaborators (private contractors, NMFS personnel, Pacific States Marine Fisheries Commission personnel) have also contributed to these projects. One staffer noted that individuals with quantitative expertise are difficult to retain, as pay and benefits are not competitive with other organizations, such as NMFS. One DFG staffer also suggested that the skill levels of non-expert staff should be increased so that they are better able to understand the data required for quantitative work and to understand the strengths and weaknesses of quantitative analyses. The Marine Region Regional Manager noted that “in general the technical staff are 20% research or data centric; 50% management centric; and the remaining 25% are a blend of both.”

Hiring and retention procedures within DFG may also affect its capacity for science. The size of the staff in the Marine Region has been declining, and retirements have left gaps in expertise. Interviewees both within and outside of the Department have noted that funds for hiring are often episodic, and when funds do become available a large number of new staff must be hired in a short time. It takes time for new staff to gain expertise, and in hiring large numbers, it may be difficult to be selective. In addition, civil-service hiring policies make it difficult to target expertise for the needs of particular positions. Doctoral-level personnel are uncommon in DFG, in contrast to an organization like NMFS. At the NMFS, most projects are led by PhD-level scientists, who supervise Master's and Bachelor's level scientists. If Civil Service rules and funding allow, it would be beneficial for DFG to increase the number of doctoral-level scientists among its staff.

DFG staff have broad responsibilities: gathering information from fisheries, understanding how fisheries operate, developing regulations, presenting information before the FGC, interacting with constituents, and responding to legislative and FGC needs, among many others. These demands, as well as limitations in expertise, limit the amount of scientific work the Department can realistically hope to carry out. As a result, DFG must utilize scientific information generated from outside: academia, other agencies, contractors, and collaborative efforts with fishermen.

Other Sources of Scientific Information

The DFG Marine Region is one element in a network of organizations and individuals gathering scientific information on the California marine environment. The information generated outside of DFG is available for use by DFG, and DFG plays a number of roles in directing or suggesting research, and in responding to research initiatives.

Research in academia, in other government agencies, and in some NGOs, provides a tremendous amount of EFI for California. Utility companies and sanitation districts generate monitoring data that provide useful time series on distribution and abundance of some species, and often provide funding for more focused research that generates other types of EFI. Similarly, some NGOs conduct basic scientific research, and provide useful data for fisheries management (such as data on diets of seabirds). Other governmental agencies, such as NMFS and fisheries agencies from other States, produce research on species managed by California or jointly by California and other agencies, and on general aspects of the marine environment. These agencies also provide conceptual advances in the theory and application of fisheries management that serve as models for California. Academia may produce the greatest volume of fishery independent EFI for California fisheries. For example, Milton Love of U.C. Santa Barbara, has studied age, growth, and reproduction in at least 23 species of exploited fishes off California. Much of what is known about the ecology of California's marine fishes has come from research by university faculty and students. For example, 22 of 35 chapter authors for the recent book *The Ecology of Marine Fishes: California and Adjacent Waters* were academic scientists. State universities and some colleges have long been active in research with relatively direct application to fisheries management (like life-history studies). Doctoral-granting universities are devoting increasing effort to research that can be used directly in fisheries management.

Some research conducted by these institutions is beyond DFG capabilities under its current configuration. For example, genetic analyses of population structure are carried out in two NMFS labs (La

Jolla and Santa Cruz) and at several universities in California. It would be inefficient for DFG to develop its own genetics lab when these other laboratories exist. Similarly, DFG is not set up for large-scale surveys of planktonic larvae and juveniles, such as those conducted under the CalCOFI program. Other areas of research, such as theoretical population modeling, are unlikely to be carried out at a large scale within DFG, but are carried out at several universities with substantial expertise in this field. Research conducted outside of DFG, then, is essential in enhancing both the volume and types of scientific knowledge available to DFG in its mission of applying scientific information to fisheries management.

DFG interacts in various ways with other providers of scientific information, both in directing or influencing the direction of outside research, and in being influenced by research originating outside of the Department. DFG can most closely control the direction of outside research by issuing contracts for particular services. Examples of contracts include some stock assessments, and a recent report on the economics of commercial fisheries in California. One DFG staffer noted that it is important for the goals of the contract to be spelled out carefully, for DFG to monitor the progress of the contract, and for DFG to assist the contractors in understanding any data that contractors might utilize. DFG also collaborates with other groups in generating EFI. For example, the Pacific Fisheries Management Council, in which DFG participates, co-manages several fisheries with the State. DFG benefits from the procedures, expertise, and review provided by PFMC in managing those species, and the PFMC model of management has been employed on fisheries that are exclusively State-managed. DFG participates in agencies such as the Pacific States Marine Fisheries Commission, and through such participation advances DFG objectives and benefits from collaborative expertise and review. The California Recreational Fisheries Survey, for example, was developed in collaboration with the PSMFC. DFG is a member of the California Cooperative Oceanic Fisheries Investigations (CalCOFI), with NMFS and the Scripps Institution of Oceanography, and participates in oceanographic surveys carried out by this organization. On a smaller scale, DFG biologists may collaborate directly with outside researchers in developing or carrying out research programs. For example, DFG biologists are collaborating with researchers from San Diego State University on lobster research, and previously collaborated with Dr. Mia Tegner of SIO on abalone research.

Several programs, such as University of California Sea Grant, University of Southern California Sea Grant, NOAA's National Undersea Research Center, the National Fish and Wildlife Foundation, and the California Ocean Protection Council, provide funding for research that generates EFI for California fisheries. DFG has provided funding for some agencies (like U.C. Sea Grant) to support research in areas that benefit DFG initiatives (such as the MLPA, in 2005-6). DFG has also provided small seed grants to initiate research; one such seed grant was used to begin research on California sheephead at U. C. Santa Barbara. Even in situations where competition for fisheries-related funding is open, knowledge of the issues facing fisheries management can sometimes help to establish priorities for research funding. A DFG staffer noted that academia has been quick to act on statements of research needs in recent stock assessments. Directing research funding toward these priorities helps to provide DFG with EFI. Finally, research conducted outside of DFG, whatever the source of funding, may provide new information, or new ways of approaching problems, that DFG itself may never have anticipated.

Vagaries of research funding affect the production of EFI by outside groups, and can undermine collaborative initiatives. For example, DFG and other groups collaborated to develop a novel fisheries-independent sampling program for nearshore fisheries, called CRANE. The program was carried out on a trial basis in 2004, based on a one-time source of funding. Since then the program has stalled because no further funding was available, although some participants in CRANE have continued aspects of this

program. Similarly, funding from the California Ocean Protection Council for the MPA assessments of carried out by the California Collaborative Fisheries Research Program (discussed below), was suspended in December, 2008 (work reportedly has resumed). We think that this demonstrates the importance of State funding for important long-term research and monitoring programs.

Fishers as Providers of EFI

Successful fishers have an intimate knowledge of many aspects of the ecology of the fish they harvest. Accessing this knowledge (so called "traditional ecological knowledge") can provide important and useful insights into harvested species and their management (e.g. Huntington 2000). Engaging fishers in collaborative research, particularly in a co-management context, can facilitate incorporation of fishers' knowledge as well as build trust and cooperation among managers and fishers (e.g., Kaplan and McCay 2004). DFG has engaged in some collaborative research. For example, as part of the California Collaborative Fisheries Research Program (<http://seagrant.mlm1.calstate.edu/research/ccfrp/>), DFG, fishermen and university scientists teamed up from 2003 to 2006 to compare CPUE from the fishery with scuba surveys as methods of estimating fish abundance in Carmel Bay (Osorio 2004, 2005, <http://seagrant.mlm1.calstate.edu/research/ccfrp/fishery-scuba-comparisons/>). Rick Starr from University of California Sea Grant Program and Mark Carr from University of California Santa Cruz worked collaboratively with two fishermen from the Monterey area and a team of divers and support staff from DFG. DFG provided project planning and computer mapping support, data consolidation, and data analysis for the project. The results indicated considerable differences between the two census approaches but a sampling program that benefits from the complementary strengths of both fishing gear and SCUBA sampling would likely result in the most comprehensive description of near shore fish assemblages. Another project under the California Collaborative Fisheries Research Program involves monitoring of Marine Protected Areas. Both the commercial passenger fishing vessel industry and commercial fishermen are involved. The monitoring protocols were developed in a series of scoping meetings that included fishermen, academic scientists, and DFG and NOAA scientists and resource managers. The final study design uniquely utilizes the knowledge and expertise of fishermen and skippers within a standardized experimental framework ensuring that the data can be utilized for both MPA and stock assessment purposes (http://seagrant.mlm1.calstate.edu/wp-content/uploads/2009/05/ccfrp_2007_final_report.pdf).

Although these and other projects have provided helpful data, DFG has not fully embraced collaborative research with fishers for a variety of reasons. Fishers may propose research on a particular species because they believe it is abundant and able to support a greater harvest. This can lead to conflict over management objectives and research design. Setting up a successful collaborative program also takes a lot of work, communication, and oversight. The sampling design must be statistically valid and enough sampling must be done to provide statistical power. Methods need to be standardized. Fishers can contribute a lot to a good research design, such as local knowledge that will help with stratification of sampling. However, collaborative projects can be expensive, especially if vessel costs and crew costs are reimbursed, so the benefits for management must be significant to justify the costs. On the other hand, such programs can be very cost-effective if they are integrated into normal fishing activities, as has been done in a pilot program for the rock-crab trap fishery off Santa Barbara (presentation before the FGC Marine Committee, July 2009).

When collaborative projects are implemented, however, fishers often become very enthusiastic participants. They like being involved, and feel invested in the research. They learn a lot about how scientific information is generated, and come to understand better the requirements of scientific management. When fishers and managers work together on scientific projects they also come to understand one another and the projects build mutual respect and trust. This can help reduce the frequent conflicts between fishers and managers.

Concluding Comments and Recommendations:

The MLMA set a new tone for science in fishery management in California. The MLMA places considerable emphasis on science as a foundation for effective fishery management. The primary management tool under the MLMA is the fishery management plan (FMP), which is to be based on the best available science. DFG is challenged to assemble a database of "essential fishery information" (EFI) for each species managed by the State. EFI establishes a benchmark for the scientific data required for effective fishery management. The Master Plan provided a list of variables that constitute EFI, which included socioeconomic variables. The Master Plan also scored fisheries as data poor, data moderate or data rich. Most CA fisheries were data poor, indicating that there were major gaps in EFI, formal stock assessment was not possible, and management had to be very precautionary. The FMPs that have been completed include research programs to gather EFI but no timetable for gathering these data and moving species from *data poor* to data moderate or data rich. DFG has imposed precautionary management on most species reflecting their data poor state and has assembled data to move some species into the data moderate class. But progress in building a base of EFI for most species is slow.

Recommendation: Set a clear timetable and specify the resources necessary to gather EFI in FMPs. Define preferred stock assessment model(s) and link EFI needs to data required to implement the stock assessment model so that management needs are met in efficient manner.

The MLMA also set a new direction for fishery management, emphasizing long term sustainable fisheries over short term harvest oriented management. Under the MLMA, fishery management was to be part of the overall management of marine ecosystems to ensure both sustainable fisheries and healthy marine ecosystems. MLMA prescribes EBM to achieve this goal. The intent to move toward EBM is affirmed in FMPs, but none of the documents state what EBM means and how it will affect management. The *NFMP* lists a number of possible indicators of fishery effects on the ecosystem but does not provide any conceptual model or framework that would connect these variables with fish production or management. Without these kinds of organizing frameworks it is difficult to assess how management will proceed, whether it will be sustainable, and how the management system will respond to future changes.

Recommendation: DFG needs to clarify the EBM model and how it relates to EFI, habitat protection/restoration, and fishery management. Some basic ecosystem thinking could be incorporated into FMPs during routine status reporting, such as food web diagrams to identify predator prey relationships, which may impact other fisheries, and any known relationships between ocean climate cycles and species productivity that may impact future yields.

Mathematical stock assessment models that provide estimates of yield from data on catch, effort, age structure and growth are fundamental to traditional fishery management. The structure of these models differs among kinds of fisheries (e.g., finfish, shellfish, crustaceans) but there are well-established models for most kinds of fisheries. Ecosystem-based models that link harvested species to their habitat and to other species in the community can enrich both single species management and multispecies management. These models provide structure to fishery management science, however, the models were not used explicitly to inform the research programs identified in FMPs.

Recommendation: FMPs should identify quantitative and conceptual models that underlie management now and in the future. These models should be used to structure the research program to ensure that the needs of assessment and, ultimately, ecosystem models are satisfied in an efficient way.

Habitat condition and its importance to sustainable fisheries is not well addressed in the Master Plan or any of the FMPs. Habitat damage by activities such as shipping, coastal development, and land based sources of pollution is commented on but not discussed in terms of its impact on fish stocks. The NFMP depends on habitat protected in the MPAs to provide required non-target species benefits, ecological health benefits, non-commercial use benefits and habitat protection. However, MPAs are not being selected with specific fishery needs in mind so that managers cannot depend on MPAs to provide all these benefits. Very near shore habitats in particular do not receive attention commensurate with their potential value and importance.

Recommendation: FMPs should be revised to consider explicitly how the broad range of habitat alterations that human activities cause in coastal waters (including estuaries and coastal marshes) are likely to impact productivity of commercial and recreational fisheries and offer ways to mitigate those impacts.

Changes in physical habitat that may result from climate change, such as changes in sea surface temperature, changes in seasonal upwelling, reduced freshwater inflow to coastal waters, are not discussed in detail in the FMPs. These changes have the potential to impact heavily on CA fisheries and deserve a comprehensive evaluation.

Recommendation: DFG should establish a technical advisory committee and initiate a series of workshops to assess the implications of both cyclical and long term changes in ocean conditions on CA fish stocks and how knowledge of these effects could be incorporated into management. CalCOFI could be a good framework for assembling such a series of workshops, because it has long been a focus for the analysis of ocean climate variation and its effect on the marine biota of California. The CalCOFI Symposium in 2009 addresses "Forecasting Fishery Productivity in the California Current," which could be an excellent starting point for workshops.

None of the FMPs consider how to integrate Marine Protected Areas (MPA) into fishery management. The NFMP identifies MPAs as a primary means of conserving essential fish habitat. Yet, MPAs are intended to serve broad ecosystem conservation objectives and the sizes and locations of MPAs are being decided in relation to many factors besides fishery management. MPAs provide both opportunities and difficulties in the scientific management of fisheries and a careful consideration of how to integrate MPAs into fishery management is needed (Field et al. 2006).

Recommendation: DFG and the FGC should clarify their policy regarding MPAs and fisheries. Managers need to be clear about whether fish within MPAs are to be considered part of the fishable stock or whether these subpopulations are to be excluded from stock assessments and setting of TACs. A workshop to discuss the implications of various policy options would help clarify the choices. Once the policy is clarified, DFG should strike a technical advisory committee to consider how management models and decisions should take account of the presence of MPAs.

MLMA and the master plan established that FMPs would be subject to peer review. This is an important advance in the use of scientific expertise in FMP development. Reviews of the WSBFMP and NFMP suffered from delays in plan preparation and time constraints and uncertainty about how best to proceed. However, the reviews did help legitimize the scientific basis of the FMPs.

Recommendation: DFG should continue the policy of peer review of FMPs and other important management actions. Experience from past peer reviews should be used to streamline the process to ensure the most efficient use of both reviewer's and DFG staff time. The CALFED science program established a process that has worked reasonably well and DFG could use experience from this program to help improve its own peer review process.

The MLMA and Master Plan promote a collegial and collaborative approach to FMP development and implementation through constituent involvement. DFG, however, appears to interpret constituent involvement rather narrowly as a consultative process with DFG firmly in control. The NFMP describes a number of successful and beneficial projects in which managers, academics and fishers worked together and suggests that more such projects would be a good idea but does not identify any particular candidate projects. Benefits of fisher's knowledge and fleet infrastructure in management as well as the engagement of fishers as part of the process cannot be realized by keeping fishers at arms length. Ultimately, collaborative research and management provide a way to reduce costs and enhance effectiveness of management (See, for example, the report on collaborative data gathering in the southern California rock crab fishery presented by Caroline Culver at the July 2009 Marine Resources Committee meeting).

Recommendation: Successful co-management of fisheries requires a high degree of trust and respect between fishers and managers. At present the necessary trust and respect appears to be lacking in most fisheries. DFG should take the initiative to develop pilot projects in collaborative data gathering and other aspects of fishery management with willing fishers as a step toward developing the necessary trust and respect.

Socioeconomic data are virtually non-existent for most fisheries and the FMPs do not provide much insight into the social and economic aspects of fishing. The NFMP identifies a list of socioeconomic EFI and suggests some ways these data could be used but does not provide a model or framework for prioritizing socioeconomic data or for incorporating the results of socioeconomic analyses into fishery management. If regional management is to become a reality, better understanding of socioeconomics will be necessary in order to achieve the "fairness" principles in the MLMA.

Recommendation: DFG should convene an advisory committee of economists and social anthropologists to develop a strategy and a plan for defining essential socioeconomic information and how it can be

used in management of CA fisheries. This should be done within the context of continuing budget constraints and the role that social and economic considerations are expected to play in sustainable fisheries. An initial workshop might be followed up by a pilot project (funded through Sea Grant or other appropriate mechanism) to test the ultimate cost and usefulness of socioeconomic EFI in fishery management.

Lack of resources (financial, professional) is often cited as an obstacle to achieving the vision of the MLMA. The *data poor* state of most fisheries means that DFG is starting from a very low baseline of information to achieve MLMA goals. Historically, DFG was a respected science organization and contributed important new knowledge about CA fisheries to the scientific literature. This contribution has fallen off considerably as resources have been squeezed. Recently, DFG has instituted a number of programs for improving fishery dependent data gathering, particularly in the sports fishery, and has been able to assemble data to move a number of finfish species from the data poor to data moderate categories. However, there is concern that DFG lacks the capacity (personnel and budget) for detailed quantitative data gathering from the majority of fisheries that it manages. There is also concern that, even if detailed quantitative data were available, DFG does not have sufficient trained staff to conduct quantitative stock assessments or to interpret the results of such surveys. Hiring processes also make it difficult for DFG to hire and retain the most highly qualified staff. DFG has a history of successfully engaging with academic researchers to fill gaps in EFI and to conduct data analyses. Academia and other research institutions (e.g. CalCOFI) can also address research questions that DFG is currently not capable of (e.g., genetic stock identification, large scale egg and larval surveys). Outside agencies are not likely to be fully committed to DFG priorities, however, so that DFG needs to retain a solid in-house capacity for science.

Recommendation: DFG needs to regain some of its lost stature as an organization that runs on a foundation of good science as this will enhance its credibility as a management organization. DFG needs to reaffirm the importance of science in sustainable fishery management and the Department's commitment to obtaining good science. At least some staff with the ability and training to undertake good science should be protected from the demands of other management duties and allowed the opportunity to conduct science relevant to implementation of the MLMA, perhaps as leaders of collaborative research teams involving other agencies (e.g., NMFS) and academics. The successful history of engaging with academics to fill gaps in EFI should be more vigorously pursued and where feasible should be extended to engage fishers and other interest groups.

With a limited and shrinking resource base, DFG has been struggling to meet the challenge of the MLMA. Phipps et al. (nd) state that: "Conventional data collection and stock assessment methods, which require large amounts of time and resources, have become a bottleneck in California Fishery Management Plan (FMP) implementation, and in the transition of fisheries to science-based management." DFG is open to alternative methods that are less time and resource intensive but these must still meet stiff quantitative requirements. And this is only a bottleneck for traditional species-focused management. Expanding the context to include socio-economic considerations and ecosystem based management creates additional data bottlenecks. A final bottleneck may be the change in management philosophy implicit in the MLMA. These obstacles greatly slow progress toward the broad goals of the MLMA.

Recommendation: DFG should be proactive in following up on the data poor fisheries workshop held in Berkeley in 2008 (<http://mdpf.mlml.calstate.edu/>) to determine if the approaches discussed in that

workshop, or other approaches, can provide workable alternatives to traditional data intense assessment models. Workshops, seminars and training sessions involving experts in management approaches relevant to the MLMA should be used to build understanding and confidence in DFG staff about the new philosophy of the MLMA.

Adaptive management is one of four general policies in the MLMA for achieving its conservation goals (Weber and Heneman 2000). Adaptive management is defined as a scientific policy that seeks to improve management by designing management actions as tools for learning, able to provide useful information regardless of whether they succeed. However, adaptive management is mentioned only briefly in the master plan and in the white sea bass and nearshore fishery management plans and the way it is referred to suggests that the authors of those plans did not fully understand the application of this tool. Adaptive management can be a powerful tool for proving understanding of complex fishery systems but its implementation involves detailed understanding of the use of models and experimental design (Walters 1986). If DFG is to make effective use of this tool, it will have to develop a full understanding of its elements and its application.

Recommendation: DFG (in collaboration with the OPC and the FGC) should organize a series of workshops offered by academics and practitioners knowledgeable about adaptive management. Personnel at all levels within DFG should be encouraged to participate in these workshops. Until such time as DFG has employees suitably trained in adaptive management, it should engage trained personnel from outside the department to assist with designing management actions as adaptive management.

The coast of California falls within the larger California Current Large Marine Ecosystem. As Halpern et al. (2009) have shown, this ecosystem is heavily impacted by a broad array of human activities and is highly sensitive to impending climate change. The West Coast Governors Agreement on Ocean Health (WCGA 2006) called for collaborative action on research and education and coordinated management to address regional issues in the California Current. It is time to take a more vigorous approach to implementing the WCGA.

Recommendation: The OPC, in consultation with the FGC, DFG and the SAT of the MLPA, should establish a committee to initiate the process of developing a comprehensive research strategy for the California Current Large Marine Ecosystem. The strategy should engage with the marine research infrastructure in Oregon and Washington to develop an inclusive research program as envisioned in the WCGA.

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Appendix 2. Responses to Scope of Work Questions

Introduction

The Scope of Work (SOW) for this lessons learned project identifies six primary questions to be addressed, and four additional questions. In particular, there is a series of questions addressing the process for developing MPAs, their content, and their role in fishery management. The SOW also leaves room for the evaluation to address other questions. The main “lessons learned” report is intended to respond to the substance of all SOW questions but does not address each one separately. The following summarizes and in some respects expands upon the main report’s responses to the SOW.

Question: Has the MLMA provided appropriate guidance for DFG and the Commission to make fishery management decisions?⁶⁶

The MLMA provides an ambitious, flexible, and reasonably coherent policy framework for use by DFG and the FGC. Its utility is constrained by a series of factors that include continued fragmentation of authority for fisheries management and an absence of accountability mechanisms. To the extent guidance appears to be lacking, it is likely a consequence of DFG and, to some extent, the FGC failing to adopt clear models that include goals, objectives, and deadlines. The statute articulates a long-term goal of sustainable fisheries and ecosystem-based management (EBM), and describes specific tools and processes intended to promote progress toward those goals. As noted in the *Passage and Implementation of California’s Marine Life Management Act*, there is an ongoing debate about the extent to which the MLMA is a set of directives to DFG and the FGC, or rather a management philosophy intended to guide, but not direct, decision making.⁶⁷ DFG and the FGC developed the specific management tools and products required by the statute, but have not prepared any FMPs without legislative direction. Given the broad lack of essential fishery information (EFI) for the state’s fisheries, the management approach necessarily should be precautionary.⁶⁸ There appears to be room for disagreement about whether the interpretation and application of precaution by DFG and the FGC over the past decade is consistent with the long-term MLMA goal of sustainability. For example:

- There appear to be few examples of restricted access being employed as a management tool in fisheries that lack even the most basic information, apart from those where FMPs have been developed.

⁶⁶ For purposes of this question, it is assumed that “appropriate guidance” means a sufficiently clear articulation of legislative objectives to shape and implement policies for fisheries management.

⁶⁷ *Passage and Implementation of California’s Marine Life Management Act*, pp. 23-25

⁶⁸ *Id.*, p. 20

- DFG does not appear to be using its discretion to set a Total Allowable Catch, or TAC, in fisheries lacking even basic EFI let alone a FMP.
- There does not appear to be an established, consistent process for the FGC to evaluate DFG's management of fisheries based on precaution under the MLMA. There is a notable absence of mechanisms in the MLMA for accountability by DFG or the FGC on collecting EFI, preparing FMPs, establishing metrics for progress toward sustainability and EBM, and implementation of meaningful adaptive management.

The MLMA was visibly effective in its first few years when DFG and the Commission were meeting clear legislative directives, i.e., guidance. The lack of accountability mechanisms has contributed to a loss of momentum. The fragmentation of authority for fisheries management provides opportunities for individual fishery participants to promote their species-specific objectives through legislative action, displacing more integrative, ecosystem-based approaches.

As noted in *Passage and Implementation of California's Marine Life Management Act* and the body of this report, the MLMA is viewed by many in DFG as setting out a basic management philosophy and leaving the details, including the interpretation of precautionary management and overall goal of sustainability, to the discretion of DFG. Looking at individual fisheries, there is room for disagreement whether DFG's exercise of its discretion has been consistent with precaution or sustainability. Taking an ecosystem perspective, there is little evidence that DFG is actively managing marine resources on this basis, and limited and uncertain evidence at best regarding progress toward sustainability. Looking at the FGC, it has not been a priority to develop explicit policy guidance that reflects the MLMA and could form the basis for a useful, ongoing discussion with DFG about marine resource management.

Question: *Has the MLMA provided significant fisheries conservation, in terms of the creation of appropriate fisheries management schemes, a process for development of fishery plans, implementation of the MLMA legislation, etc.?*

The draft report concludes that reliable judgments about progress toward sustainability cannot be made at this time. Only a few FMPs have been created but other fishery policies have been utilized to support precautionary management. The report recommends prompt adoption of a robust management plan by the FGC.

Question: *How does the MLMA work with other state laws and policies (e.g., the Fish and Game Commission's policy on restricted access)?*

At this time there is poor articulation by DFG and the Commission of the relationship of the MLMA and MLPA. This lack of clarity is a source of confusion and conflict among fishers, NGOs, scientists, and the State. As noted in the *Passage and Implementation of California's Marine Life Management Act*, many

elements of the MLMA and MLPA were initially part of a single piece of legislation. The political and legislative processes dictated that they be enacted separately, and since that time there has been a lack of clarity about their relationship. We note that legal counsel for DFG recently circulated an interesting comparison of restricted access provisions in the MLMA and the FGC's policy. Our work on this report does not indicate any significant conflict between these policy tools.

Question: How have individual Fisheries Management Plans (FMPs) advanced or not advanced the goals and objectives of the MLMA (e.g., compare and contrast individual FMPs)?

Question: What resources and expertise are needed to effectively prepare and implement a FMP?

Question: Are there areas of the FMP development process that can be streamlined for faster implementation?

Question: Do FMPs adequately allow for adaptive management?

Question: Is the FMP creation process efficient and effective?

All of these questions are addressed in the draft report.

Question: What has been the experience with peer review and how might it be improved?

MLMA and the Master Plan established that FMPs would be subject to peer review. This is an important advance in the use of scientific expertise in FMP development. Reviews of the WSB FMP and NFMP suffered from delays in plan preparation, time constraints, and uncertainty about how best to proceed. However, the reviews did help legitimize the scientific basis of the FMPs. DFG should continue the policy of peer review of FMPs and other important management actions. Experience from past peer reviews should be used to streamline the process to ensure the most efficient use of both reviewers' and DFG staff time. The CALFED science program established a process that has worked reasonably well and DFG could use experience from this program to help improve its own peer review process. This topic is discussed further in Appendix 1.

Question: Are fisheries prioritized in a transparent and practical manner?

The prioritization of species for development of FMPs is one of the strongest sections of the Master Plan. The long list of species for which the State has management responsibility is developed and validated with assistance from numerous outside experts. Methods of fishery prioritization were reviewed and a list of criteria was developed for California fisheries. The preliminary prioritization approach was sent to marine fishery experts for review, and ultimately separate approaches for finfish (two different approaches), invertebrates and marine algae were chosen. Species were analyzed and ranked in terms of priority for developing a FMP within categories (finfish, invertebrates, algae) and a

final subjective assessment was made to select the top-ranked species. The approach was logical, drew on external expertise for validation, and made good use of available science. Unfortunately, there has been little follow through as only three FMPs (white sea bass, near shore finfish, market squid) and one conservation plan (abalone) have been developed since passage of the MLMA. See the discussion in Appendix 1.

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